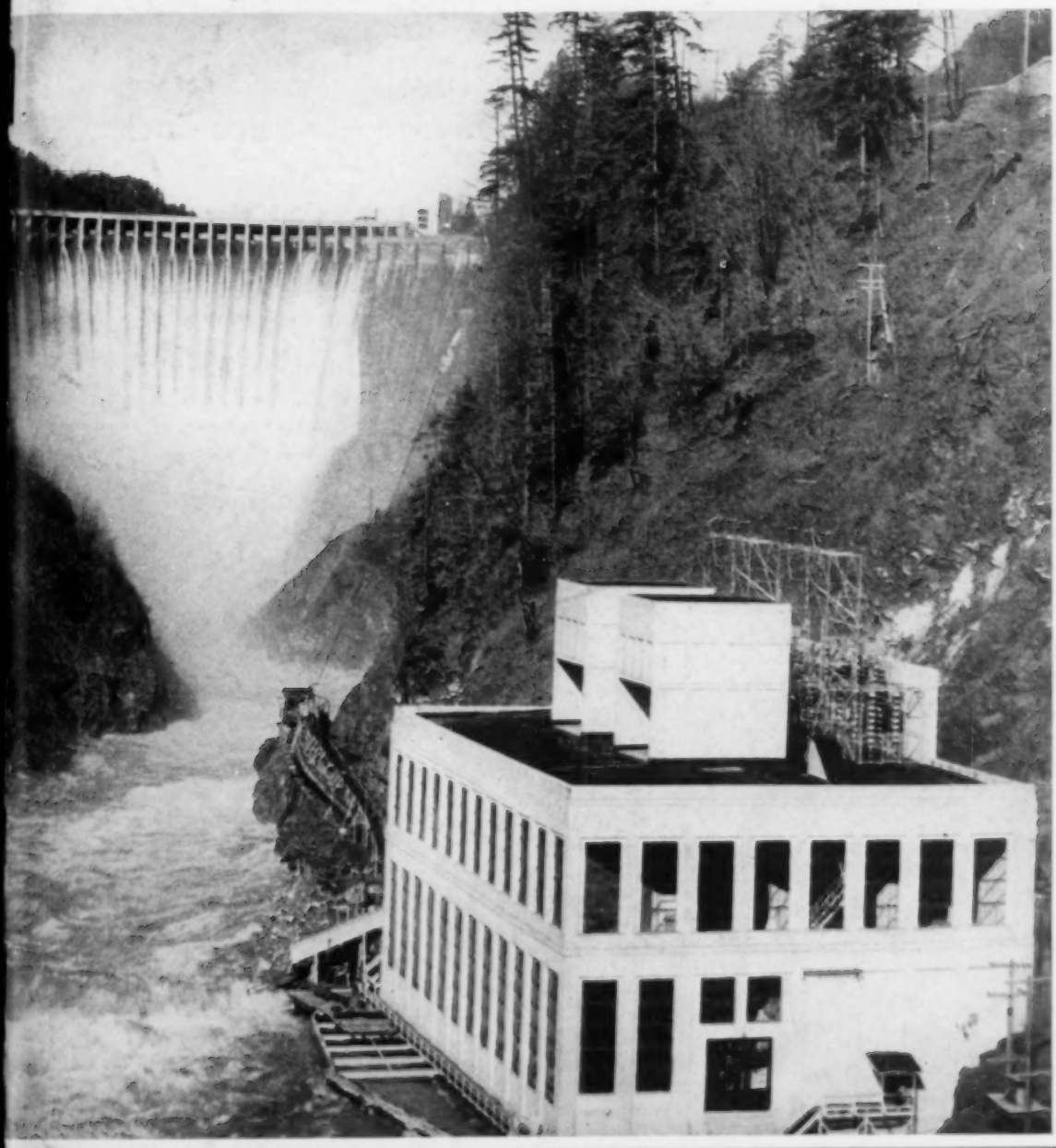
Compressed Air Magazine

APRIL 1947



BAKER RIVER
HYDRO PLANT

Unit of the Puget Sound
Power & Light Company
in scenic western area

(Photo by Lloyd Seabury)

VOLUME 52 • NUMBER 4 NEW YORK • LONDON

DRILL GREATER FOOTAGE at Lower Cost

Use Effective Lubrication to Increase Drill Life and Reduce Maintenance Cost

You can't buy more effective lubrication than Texaco Rock Drill Lubricants (E.P.) — and those letters "E.P." are an important reason why. They mean the oil has Extreme Pressure properties . . . extra high film strength to protect drills under the toughest conditions.

In addition, Texaco Rock Drill Lubricants (E.P.) flow readily at all temperatures, resist oxidation, cling protectively to moving parts and reduce wear. They prevent rust and corrosion whether drills are running or idle.

This all-around protection keeps drills running smoothly and on the job longer, with less downtime for repairs and overhauls. That's why operators and drill doctors everywhere prefer Texaco Rock Drill Lubricants (E.P.) and why leading rock drill manufacturers approve them.

Call on Texaco Lubrication Engineering Service for helpful suggestions on drill operation and maintenance. Contact the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

KEEP COMPRESSOR VALVES CLEAN

Here, too, effective lubrication is vital. *Texaco Alcaid, Algol and Ursa Oils* provide effective lubrication, prevent hard carbon formations, keep valves clean and active, rings free, ports open and air lines clear. Your Texaco Lubrication Engineer will recommend the right one to keep your compressors running right — efficiently and economically.

TEXACO

TEXACO Rock Drill Lubricants (E. P.)

Tune in . . . TEXACO STAR THEATRE presents the NEW TONY MARTIN SHOW every Sunday night. See newspaper for time and station.

WHY Clean Intake Filters More Than Once A Year?

YOU DON'T NEED TO WITH STAYNEW!!!

"When I first started as a maintenance engineer . . . more years ago than I like to admit . . . I found out for what long periods Staynew Intake Filters operate before cleaning is necessary.

"What's more, I found out that the high initial efficiency of Staynew Filters actually *increases* with use, because dust accumulates on the fins and forms a filter-aid of the very material being handled!"

Efficient Operation Up To 20 Months Reported By STAYNEW Users

TEXAS OIL OPERATOR:

"Conditions severe, but Staynew filters require cleaning only once every 15 months."

PENNSYLVANIA STEEL MILL:

"Staynew filters cleaned every 12 months."

MID-WEST CONCERN:

"Staynews throughout plant —average cleaning period, 18 months."

WEST COAST MANUFACTURER:

"Staynew intake filters operating at maximum efficiency after 20 months continuous service."

Model KE

Model C

Model D

Model DS

Model IDR

Models F and G

And When Staynews Do Require Cleaning... IT'S A CINCH!

These Staynew Intake Filters are dry type. There are no moving parts, no liquids, no reservoirs to be re-charged. They can be cleaned in just a few minutes by either vacuum or washing.

6 Models From 5 to 16,000 CFM

All Feature Original Radial Fin Design, Providing Maximum Filtering Area in Smallest Possible Space.

Model KE For small capacity use where weather housing is not required.

Model C Original *Protectomotor* design. For small capacity use where weather housing is required.

Model D The standard for heavy duty intake service on large engines and compressors.

Model DS Similar to Model D with the addition of a silencing chamber.

Model IDR Has the convenience of ground level installation plus the advantage of high level air intake.

Models F and G Low cost units for medium intake sizes.

COMPLETE DETAILS ON REQUEST

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

DOLLINGER CORPORATION

7 CENTRE PK., ROCHESTER 3, N. Y.

Representatives in Principal Cities

FOR LEAKPROOF, TROUBLE-FREE PIPE RUNS

Cut-a-way view of a Walseal Tee showing ring of silver brazed alloy, and completed Silbraz joint.

Specify Walseal* Products

On all types of piping jobs where Type "B" copper or red brass pipe is used, trouble can be avoided by installing Silbraz* joints — made with Walseal valves, fittings and flanges.

Threadless, patented Silbraz joints are silver brazed (not soft soldered) pipe joints that are leakproof, trouble-free — permanent . . . connections that will not creep or pull apart; that literally join with the piping system to form a "one-piece pipe line". Thus, these modern joints eliminate the need for maintenance and costly repairs — especially important where lowered operating costs are imperative.

For complete details on the modern Silbraz joint, made with Walseal products, write for a copy of Walworth Circular 84.

**Patented — Reg. U. S. Patent Office.*

Recommended for

- **Hot and Cold Water Circulating Systems**
- **Boiler Feed Lines**
- **Steam Return Lines**
- **Condensate Lines**
- **Low and High Pressure Air Systems**
- **Lubricating Oil Circulating Systems**
- **Industrial Gas Piping**
- **Solvent and Vacuum Piping Systems**

Make it a "one-piece pipe line" with WALSEAL

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Salt of the Earth!

...Compressors and Blowers

SALT? Yes, like salt to the human body, air and gas compressors, and turbo-blowers are essential to modern industry.

THE EARTH? Serving on *land* and *sea* all over the earth you'll find hundreds of thousands of many types of I-R Compressors and Turbo-Blowers.

SALT OF THE EARTH? By that we mean the best in *quality*... quality that a manufacturer builds into the machine to assure lower-cost operation, greater dependability, and longer life.

Ingersoll-Rand has always endeavored to design and build the best compressors and turbo-blowers in the world, to properly apply each machine to its job, and to make sure that each compressor meets the conditions for which it is sold. These are good reasons for consulting Ingersoll-Rand the next time you have a problem of compressing air or gas. There is a branch office near you.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 1-946

In intricate processes I-R Compressors, Vacuum Pumps, and Blowers create vacuums and pressures up to 15,000 psi, making it possible to produce huge quantities of gasoline, synthetic rubber, synthetic ammonia for fertilizers and explosives, plastics, and an ever increasing number of new chemical and petroleum products. Turbo-blowers, in sizes up to 21,000 hp, provide combustion air for producing iron, steel, copper, etc.

Compressors distribute gas to industrial centers and push partially spent gasses back into oil-field sands for future use. They compress refrigerants that preserve foods in shipment and storage.

In mines, on production lines, on highways and construction jobs, and aboard ship, compressors generate the Air Power that performs thousands of jobs quicker, easier, and cheaper, and many that cannot be done in any other way.

The World's Largest Builders of Air and Gas Compressors

What's The Limit?

Fourteen thousand feet in the air, scientists dropped pellets of dry ice into a cloud and created a snow storm. *Now man can make snow fall where he wants it!* Will we soon create great reservoirs of moisture for arid regions by storing snow in the hills? What's the Limit?

IS *Porous Chrome* THE ENGINE-LIFE PISTON RING?

In spite of the check-test records from millions of rings now in service on gasoline and diesel engines, we're not able to give a final answer to that question.

We do know that POROUS CHROME [VAN DER HORST PROCESS] multiplies piston ring life by four—*even five!* We can tell you that the gentle honing action of these rings causes the entire set to seat within the first hour of operation, thus eliminating the costly wear of the break-in period. We can tell you that Koppers American Hammered POROUS CHROME rings *cut cylinder wear in half!*

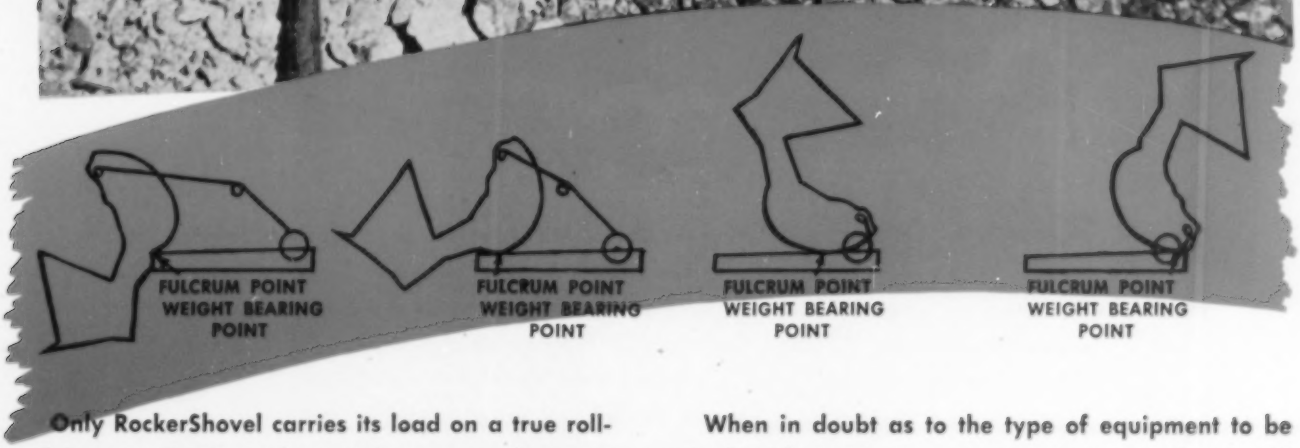
These amazing piston rings are produced for all types of compressor equipment as well as for diesel and gasoline engines. Specify them on new equipment—use them on overhauls. For more specific details concerning *your* motor, address Koppers Company, Inc., Piston Ring Division, Box 626, Baltimore 3, Maryland.

KOPPERS

American Hammered Piston Rings

IN EVERY SIZE—OF EVERY TYPE—FOR EVERY SERVICE

The RockerShovel *Fulcrum Principle*



Only RockerShovel carries its load on a true rolling fulcrum. That is — the weight rests on the point of contact with the rolling arm and the deck. This combined with Eimco's patented rocker-arm profile gives the matchless shoveling action of RockerShovels and permits their simple rugged construction with fewer parts, less maintenance and delivering more load with less power.

When in need of loading equipment, call on Eimco. As originators of the RockerShovel type of mechanical loader, we have the experience to advise you correctly.

When in doubt as to the type of equipment to be purchased, insist on a competitive test. Eimco will gladly cooperate.

EIMCO

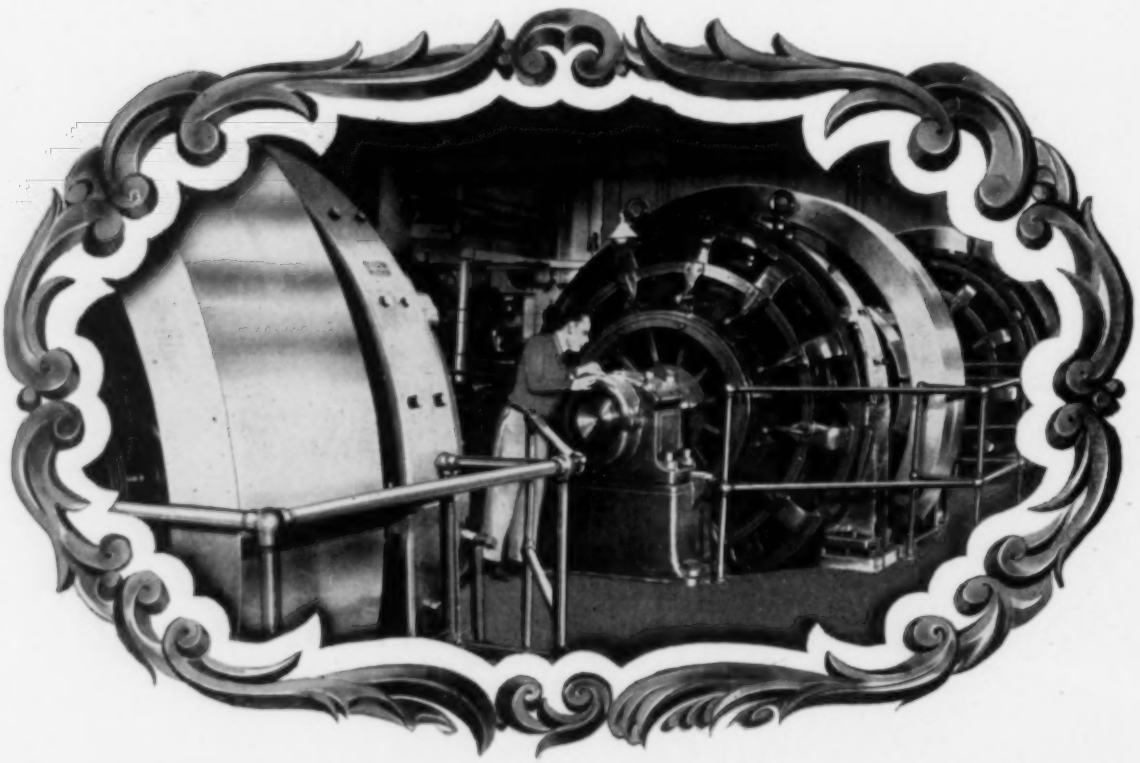
THE EIMCO CORPORATION

The World's Largest Manufacturer of Underground Rock Loading Machines

Executive Offices and Factories — Salt Lake City 8, Utah: Branches — 67 Wall St., New York 5 — 3319 So. Wallace, St., Chicago 16 — Mills Bldg., El Paso — 1217 - 7th St., Sacramento 14

We're Looking for the Oldest Burke-Motor or Generator in Active Service Today

SINCE 1891 we've built hundreds of large Burke Motors and Generators and because all of us at Burke take pride in building well, our Quarter-Century Club at Burke expressed a desire to recognize in some fitting manner the oldest Burke Motor, 200 HP and larger, or Generator, 150 Kw. and larger, in active service today. We are writing to old users but thought, that this message in the trade papers, would locate our champion immediately. Drop us a line about your old Burke Motor or Generator and a photo if available and give us the name of the man or men largely responsible for the good service.

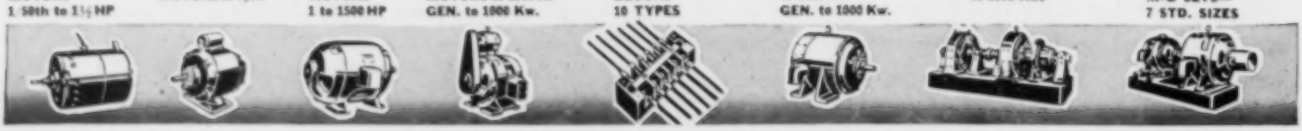


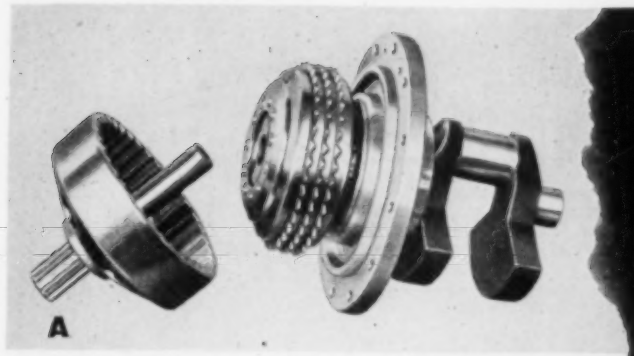
A. J. Kenning, CHIEF ENGINEER of the BENJAMIN FRANKLIN HOTEL of PHILADELPHIA presents the 22 year old Burke Generators under his care as follows: "The three Burke Generators we installed twenty-two (22) years ago are giving us the same satisfactory service today as they did when first installed. They are coupled to Erie Ball Engines. Number one generator commutator was turned down seven years ago, Number 2 and 3 have never been turned down. We have installed four sets of brushes on each generator, otherwise we never spent any money in twenty-two years on these generators. They are in the best of running condition".

Write for condensed catalog of Burke products

BURKE ELECTRIC COMPANY 2074 W. 12th ST. ERIE, PA.

UNIVERSAL MOTORS 1/50th to 1½ HP	SINGLE PHASE MOTORS to ½ HP	INDUCTION MOTORS 1 to 1500 HP	SYNCHRONOUS MOTORS to 1500 HP GEN. to 1000 Kw.	TERMINAL BLOCKS 10 TYPES	D.C. MOTORS to 1500 HP GEN. to 1000 Kw.	M-G SETS to 1000 Kw.	HIGH CYCLE M-G SETS— 7 STD. SIZES





A

CLUTCHES FOR THE HARD JOBS

When conventional type clutches will not meet your needs, we will design the right clutch for your equipment, and make it in any quantity desired.

In addition to our regular line of shoe and *Flex-Disc* clutches, we make a large number of special clutches to meet unusual or severe operating conditions. A few of these are:

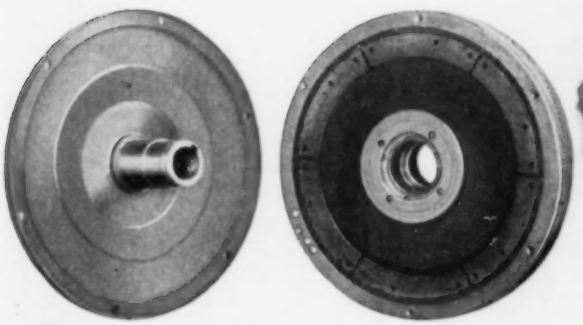
A. Multiple disc with automatic air control. Capacity 20 H.P. at 3600 R.P.M. Weight 3 lbs. 2 oz.

B. Railroad car generator clutch, automatic, centrifugally operated. 20 KW capacity.

C. Punch Press clutch with 14" cone. 35,000 lb./in. torque capacity for 35 ton press.

D. Power shovel swing clutch. *Air cooled.* 14" double disc, 24,000 lb./in. torque capacity.

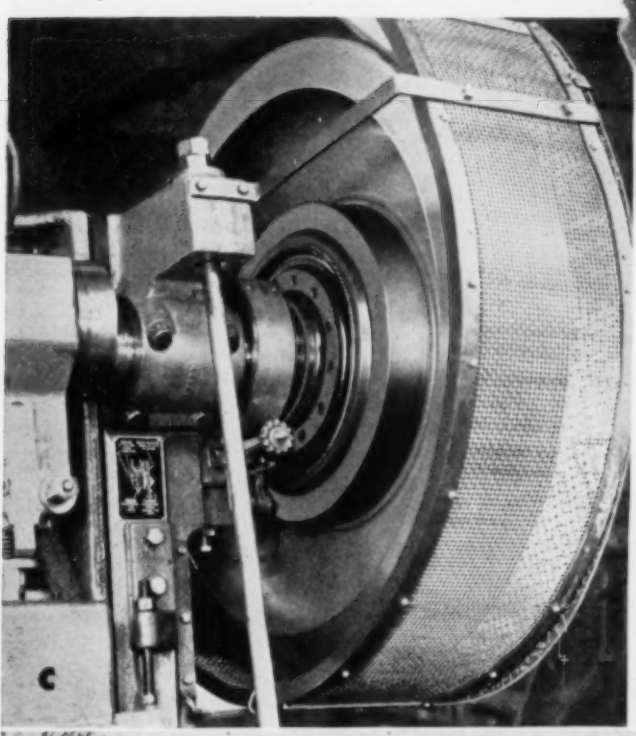
Our engineers and our newly equipped plant will cooperate with you on any special clutch problems.



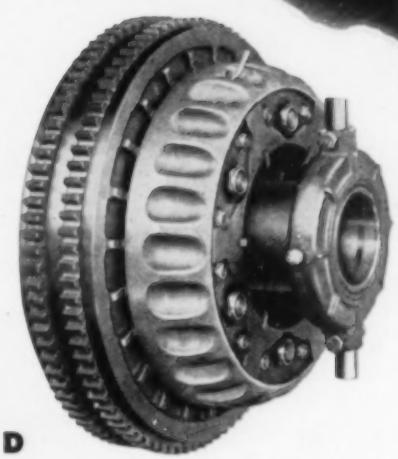
B

INDUSTRIAL CLUTCH CORPORATION

515 FREDERICK STREET WAUKESHA, WISCONSIN



C



D

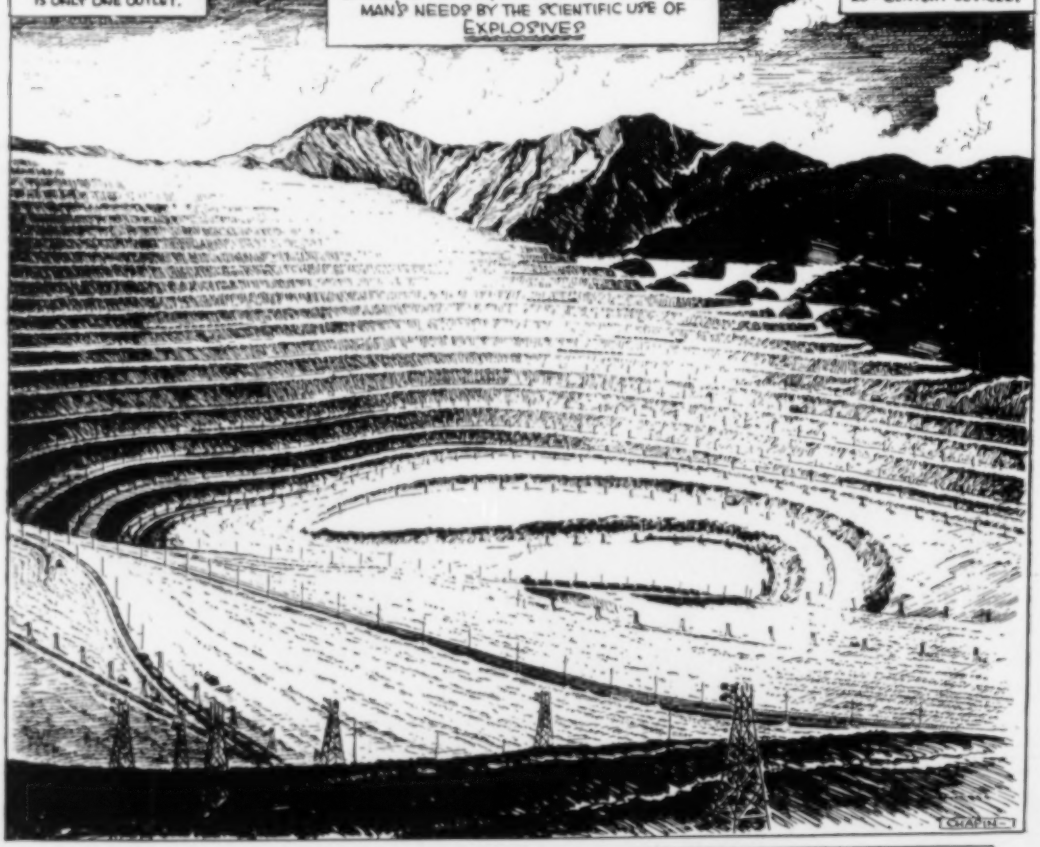
The Labors of a Modern Hercules – COPPER

COPPER, FIRST METAL MASTERED BY MAN, SERVED THE EGYPTIANS 5000 YEARS BEFORE CHRIST, AND LIFTED THEIR WEAPONS AND HOUSEHOLD UTENSILS OUT OF THE STONE AGE.
COPPER, NEXT TO IRON THE WORLD'S MOST IMPORTANT METAL, MAKES POSSIBLE THE AMAZING ACHIEVEMENTS OF THE FABULOUS ELECTRICAL AGE.
THE PRODUCTION OF THIS MARVELOUS METAL WOULD BE IMPOSSIBLE WITHOUT THE USE OF EXPLOSIVES

DURING RECENT WAR YEARS MOST OF THE PRODIGIOUS OUTPUT OF COPPER WENT INTO WAR MATERIALS FOR THE U.S. AND OUR ALLIES, PRODUCTION IN ONE YEAR ALONE BEING 2 BILLION POUNDS. IN PEACE TIME, MORE THAN ONE HALF OF ITS PRODUCTION GOES INTO ELECTRICAL USES, OF WHICH MILLIONS OF MILES OF TELEPHONE WIRE IS ONLY ONE OUTLET.

COPPER, WHERE FOUND THINLY TRICKLING THROUGH GEOLOGICAL STRATA DEEP IN OLD EARTH'S FASTNESSES, IS MINED AND LOOSED FOR MAN'S NEEDS BY THE SCIENTIFIC USE OF EXPLOSIVES

COPPER GIRDLES THE GLOBE WITH MESSAGES, BRIGHTENS THE WORLD WITH LIGHT, FLASHES POWER TO INDUSTRY AND MYRIADS OF HOMES, TRANSMITS SPEED TO TRAINS AND TROLLEYS, ACTIVATES MILLIONS OF MOTOR CARS, TRUCKS, BOATS, PLANES, HOUSEHOLD CONVENIENCES AND INNUMERABLE OTHER 20TH CENTURY DEVICES.

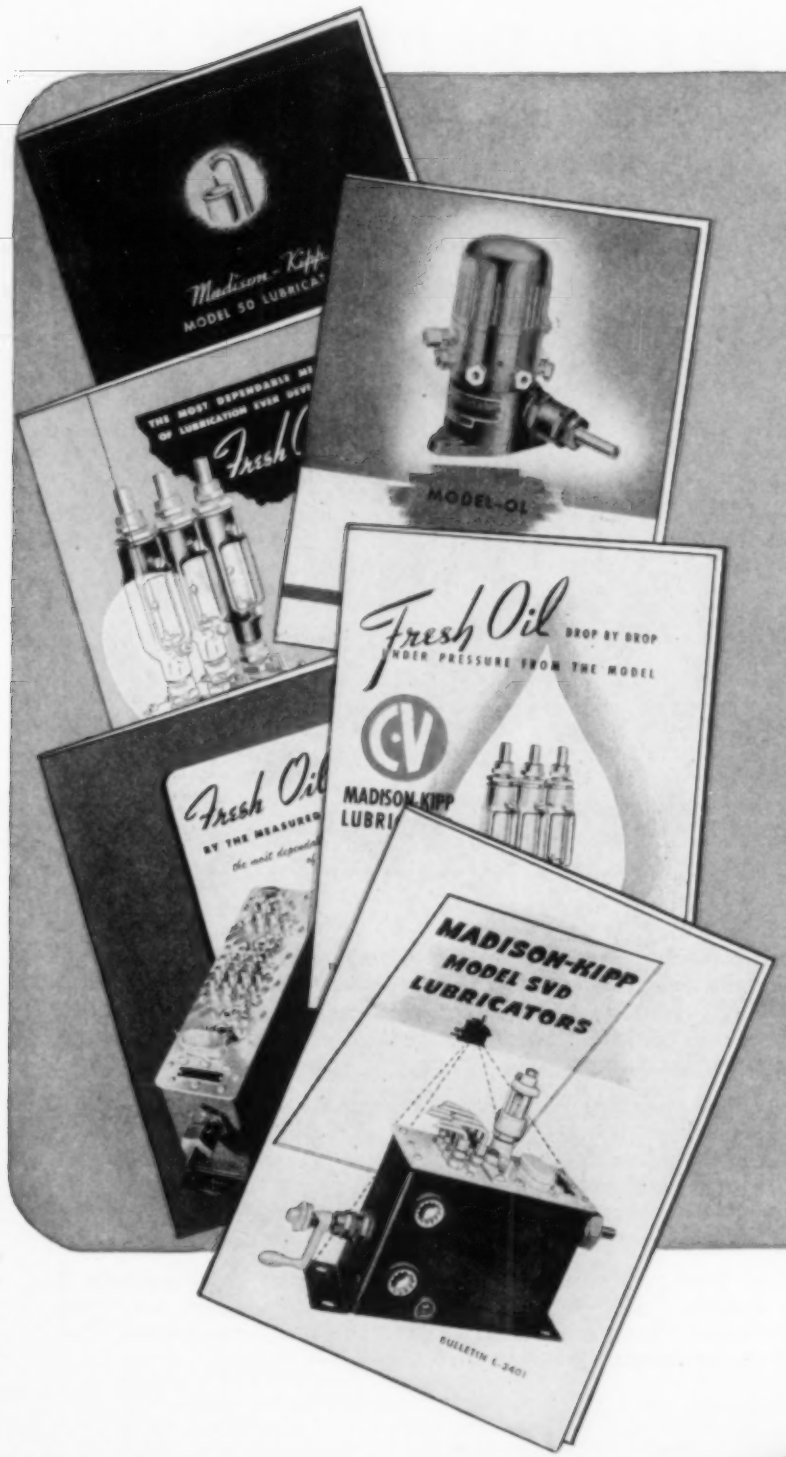


COPPER, STREWN SPARINGLY UNDER MOUNTAIN-TOPS IS SCOOPED OUT TERRACE UPON TERRACE BY PIGMY MAN AMID SETTINGS OF FANTASTIC GRANDEUR.
EVEN THE WRESTING OF THIS ELUSIVE METAL FROM EARTH'S TIGHT GRASP IS AIDED BY COPPER ITSELF AS THE INSTRUMENT OF TRANSMITTED POWER THROUGH OUT THE WORKINGS, AND IT PROVIDES THE IMPULSE TO EXPLOSIVES THAT RELEASES COPPER FOR EVER HUNGRY INDUSTRIES.

HERCULES

HERCULES POWDER COMPANY
932 King St., Wilmington 99, Del.

XB74

SMOOTH AND CONTINUOUS OPERATION HINGES ON THE LUBRICATION SYSTEM *

MADISON-KIPP is the most dependable lubrication system ever developed. It is applied as original equipment on America's *finest* machine tools, work engines, and compressors.

You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy where oil under pressure fed drop by drop can be installed.

MADISON-KIPP CORPORATION

202 WAUBESA STREET, MADISON 4, WISCONSIN, U. S. A.

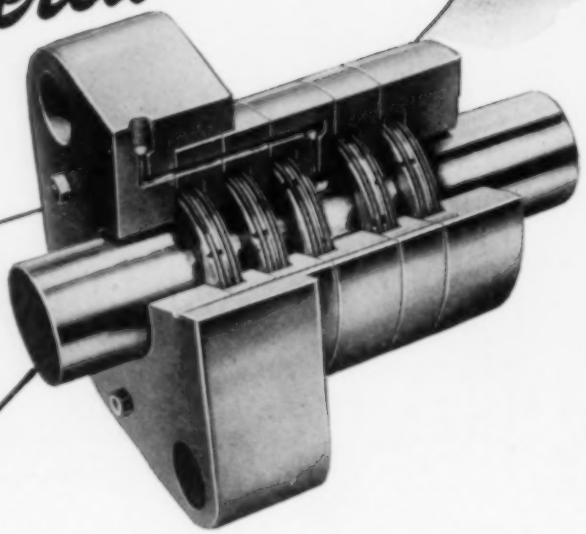
ANCIENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

BETTER PACKING FOR MORE EFFICIENT RESULTS—THROUGH METALLURGY

COOK METALLIC PACKINGS are "Precisioneered"



...it starts in the foundry!

Metallic packing must be precision manufactured if it is to provide a positive pressure seal. Experienced workmanship, careful assembly, adequate control and checking are all-important ingredients in attaining the proper close tolerances and the correct surface finishes.

In Cook Packings, however, "precisioneering" begins in the foundry where special wear-resisting materials are produced and carefully controlled by a metallurgist of national repute. In the industrial metal packing industry, only Cook operates its own ferrous and non-ferrous foundries—only Cook provides vital wearing parts of its own development and control.

Next time you order equipment, it will pay big dividends if you specify Cook Packings, because Cook Packings are "precisioneered" from the foundry to the shipping department. For existing equipment, write us direct.

Sealing Pressures

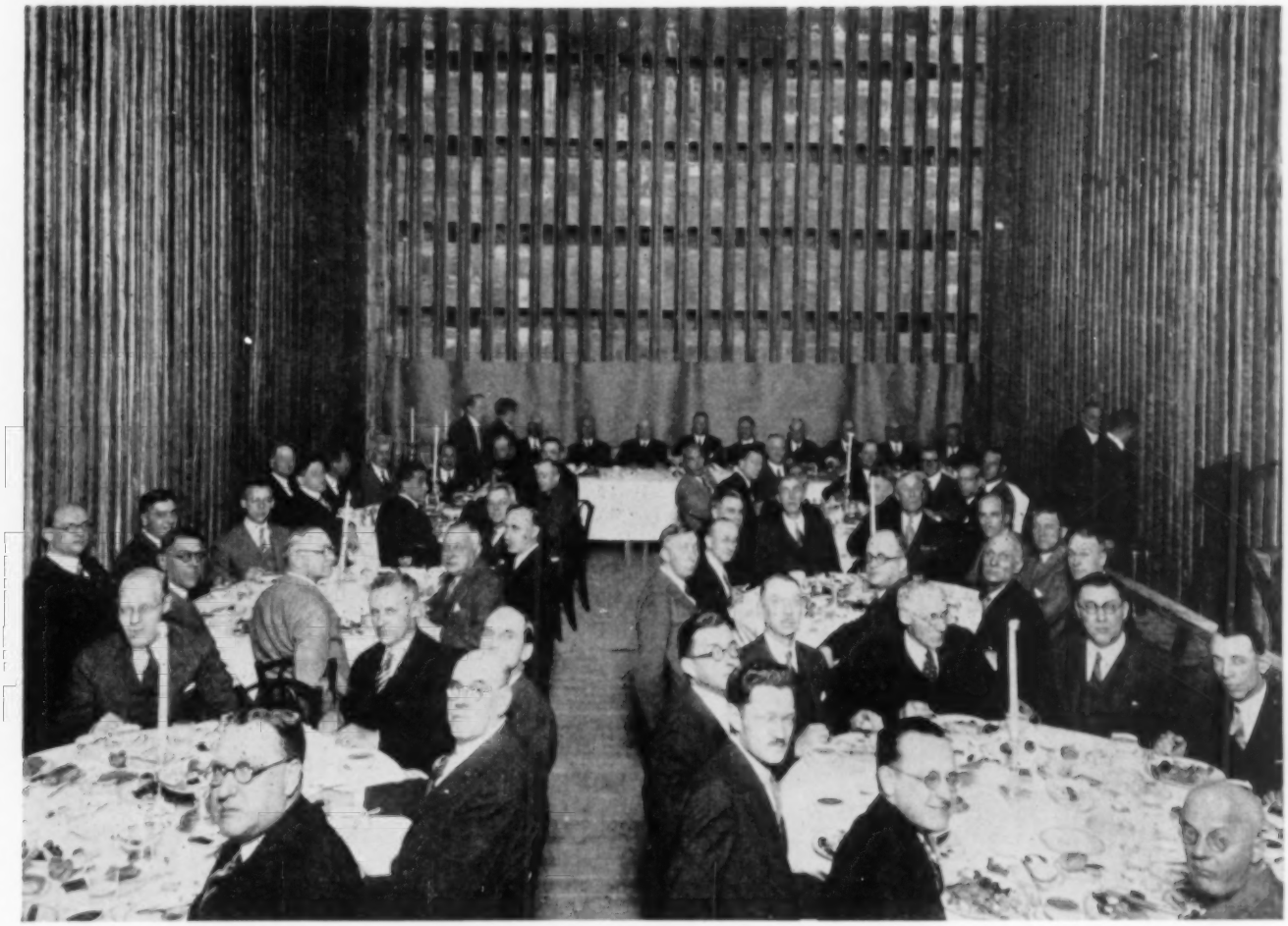
Since 1888

C. LEE COOK MANUFACTURING CO.

INCORPORATED

LOUISVILLE KENTUCKY

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA



WORLD'S FIRST *million-pound boiler!*

At noon on December 2, 1929, ninety people lunched in a room which a few hours later had an average temperature of about 2500 deg. Fahr. Steel tubes formed the walls. 85 feet overhead were the dim outlines of huge drums. This improvised dining room was the furnace of the first boiler unit to produce a million pounds of steam per hour, and the luncheon celebrated the completion of three such units in the East River Station of the CONSOLIDATED EDISON COMPANY OF NEW YORK.

This unusual event marked a notable step forward in the economics of steam and power generation. A million-pound boiler costs substantially less to install and operate than two half-million pound units. Yet, until the East River installation — designed and built by Combustion Engineering — had demonstrated that a million-pound output from a single boiler was practical, there had been only one plant in the country with boilers capable of producing even half a million pounds. Now there are many installations for capacities above 500,000 pounds and, in the million-pound class, there are twelve units in service and four on order. Of these sixteen, eleven are Combustion Engineering designed.

The spectacular comparisons given below may help you to visualize a million-pound boiler, probably the biggest single production unit you'll find anywhere in industry. Combustion Engineering is proud of the engineering resources and manufacturing facilities that enabled it to build the first million-pound boiler — and a majority of those that followed it. And these same resources and facilities are available to you when you select *any* C-E Steam Generating Unit, small or large.

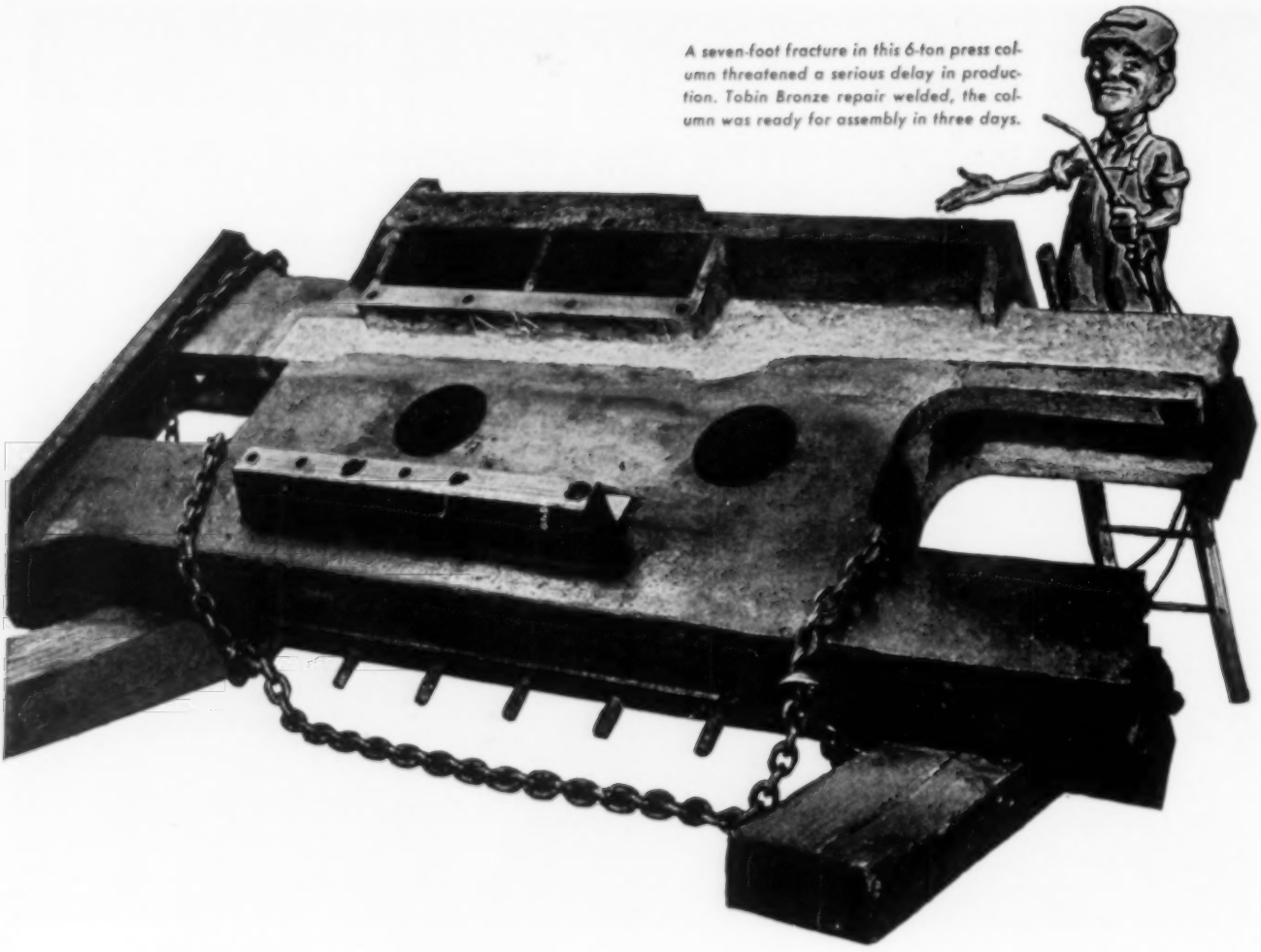
• A typical million-pound boiler is about ten stories high. • It's as wide as a four-lane highway. • The space in 5 six-room houses would just fill its furnace. • In one hour it burns 45 tons of coal, pulverized to the fineness of flour, with nearly 90 per cent efficiency. • The steam it produces would be sufficient to heat ten thousand average homes.

B-106

COMBUSTION ENGINEERING

200 Madison Avenue • New York 16, N. Y.

C-E installations cover all steam generating requirements from 30 horsepower stoker-fired boilers to the largest power station units.



A seven-foot fracture in this 6-ton press column threatened a serious delay in production. Tobin Bronze repair welded, the column was ready for assembly in three days.

Bronze Repair Welding becomes increasingly important

WITH REPLACEMENTS taking weeks or months, Bronze repair welding is being used on an ever-increasing scale for reclaiming broken, fractured or worn equipment.

Bronze welding is not new. For years this method of low-temperature repair welding has been used by many shops to salvage costly machine tools, production parts and equipment, and for building up worn surfaces.

Almost any part made of cast iron, steel, malleable iron or copper alloys can be Bronze welded quickly, dependably, and at a fraction of the cost of new replacement parts. For detailed information on Anaconda Bronze Welding Rods, write for Publication B-13. 45106

ANACONDA

Anaconda Bronze Welding Rods

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

Piping jobs move faster when all materials are CRANE

You save time on piping specifications! You save time in ordering materials! You save on installation time! Standardizing on Crane equipment does all that—and more—for you.

Take this air conditioning system, for example. Everything in piping for the installation is in the Crane line. Good, dependable materials down to the last item. From design to erection to maintenance, an all-Crane job moves faster—with better performance assured by this 3-way advantage—

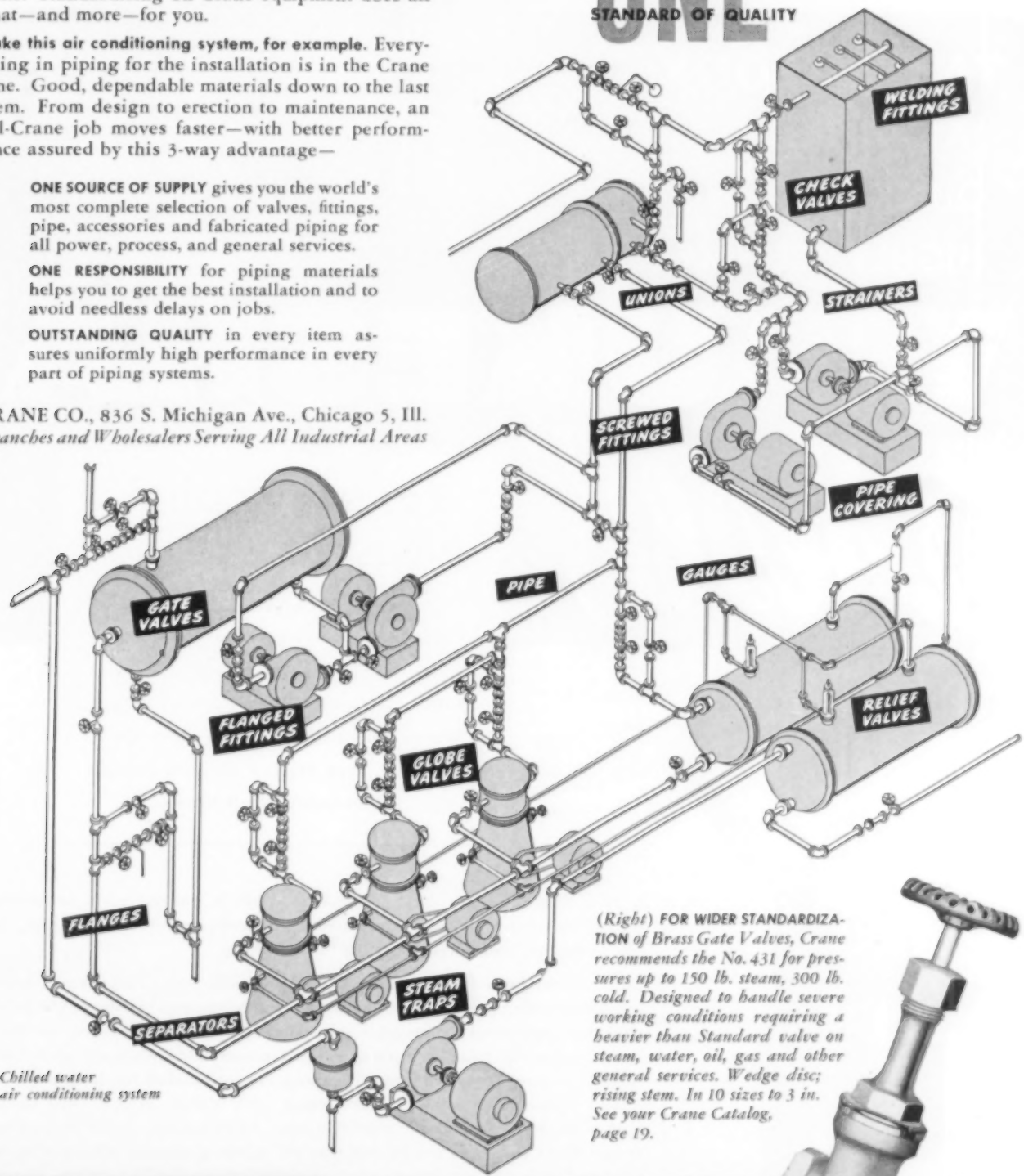
ONE SOURCE OF SUPPLY gives you the world's most complete selection of valves, fittings, pipe, accessories and fabricated piping for all power, process, and general services.

ONE RESPONSIBILITY for piping materials helps you to get the best installation and to avoid needless delays on jobs.

OUTSTANDING QUALITY in every item assures uniformly high performance in every part of piping systems.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Chilled water air conditioning system

(Right) **FOR WIDER STANDARDIZATION** *of Brass Gate Valves, Crane recommends the No. 431 for pressures up to 150 lb. steam, 300 lb. cold. Designed to handle severe working conditions requiring a heavier than Standard valve on steam, water, oil, gas and other general services. Wedge disc; rising stem. In 10 sizes to 3 in. See your Crane Catalog, page 19.*

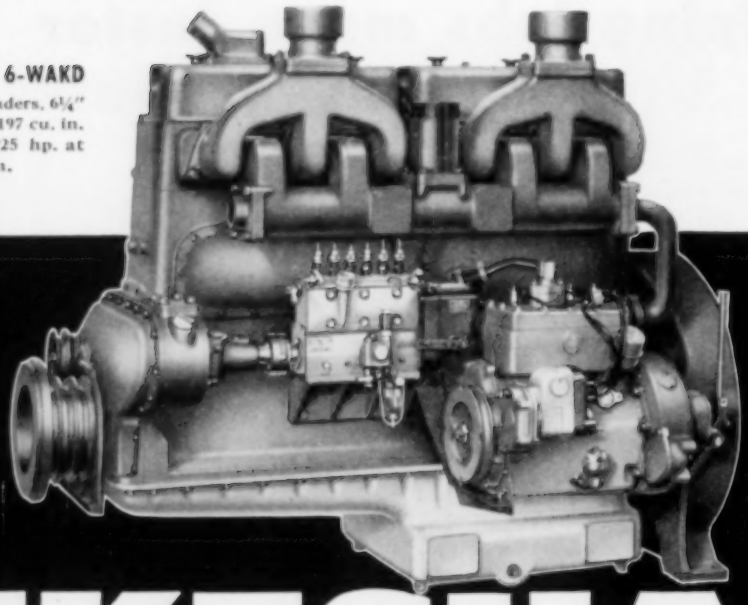
EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

Model 6-WAKD
Six cylinders, 6¼" x 6½", 1197 cu. in. displ., 225 hp. at 1600 rpm.



TAKE A LOOK AT THIS HUSKY QUICK-STARTING HIGHLY FLEXIBLE

WAUKESHA *Diesel*

for HEAVY-DUTY INDUSTRIAL SERVICE

Shovels, Air Compressors, Oil Field Drilling, Off-Highway Trucking, Crawler Tractors, Logging, Saw Mills, Cotton Gins, Irrigation Pumps, Water Supply, Electric Power Generation, and Heavy Construction Machinery of all kinds.

● This big, new, four-cycle Waukesha Diesel is packed with *performance proved* features that give super power, smoothness and acceleration, high fuel economy, and longer life with lower upkeep.

These modern construction and design features include: Large, seven-bearing crankshaft, with hardened crankpins and main bearings testing to 600 Brinell; vibration dampener; removable, wet-sleeve cylinders hardened to 350-400 Brinell; aluminum pistons with six rings (4 non-sticking, wedge-type; 2 straight side oil control rings, and with top ring chrome plated for long life); rifle-drilled connecting rods—I-beam section with deeply ribbed caps held by four heat-treated cap bolts; precision-type, steel-backed, heavy-duty, Diesel-design main bearings; intake and exhaust valves of chrome silicon alloy with hardened exhaust seat inserts; full pressure lubrication by outside mounted positive gear-type pump; large capacity oil cooler mounted on cylinder block; American Bosch injection pump; 24-volt electric starting system, with glow plugs, or gasoline starting engine.

Consult Waukesha engineers about your special problems and engine needs.

WAUKESHA MOTOR COMPANY · WAUKESHA, WIS.
NEW YORK · TULSA · LOS ANGELES

AIR POWERED
SCREW DRIVER IS THE ANSWER

MINIMUM SPOILAGE
EASE OF HANDLING
INCREASED PRODUCTION

The picture above shows an Ingersoll-Rand Size OOOBLC air-powered screw driver applying four No. 8 screws that hold the leads to the brick on an automatic waffle iron. This insulating brick is very brittle and torque on the screw must be accurately controlled.

The I-R Screw Driver features a cushion clutch that minimizes rotary impacts and allows delicate torque adjustment. An integral part of the cushion clutch is an engaging clutch which permits the motor to run but rotates the bit only when the operator exerts a slight forward pressure on the screw driver.

Air tools are definitely superior for screw driving. I-R Screw Drivers offer you many advantages ... small size ... light weight ... more power per pound ... accurate torque adjustment ... dependability ... run cool to the touch.

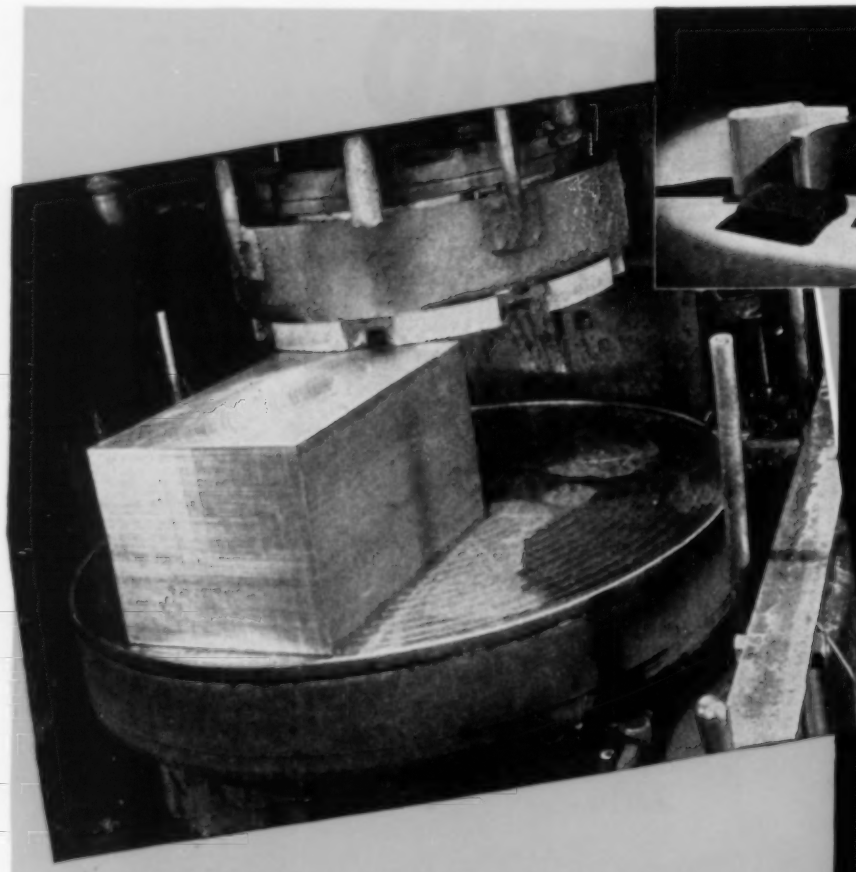
Air-powered screw drivers may be the answer to some of your problems. A reversible model is available in every instance where a reversible tool can be used to greater advantage. Call our nearest branch office for further details or a demonstration.

Ingersoll-Rand

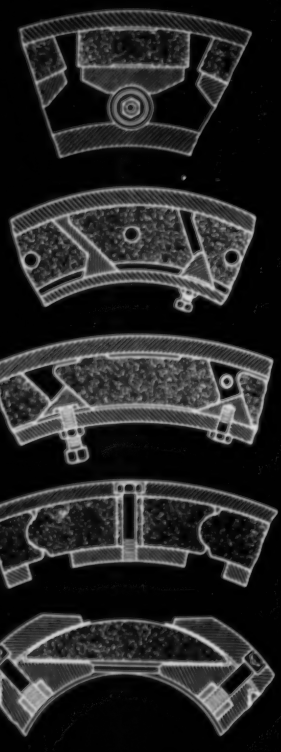
11 BROADWAY, NEW YORK 4, N. Y.

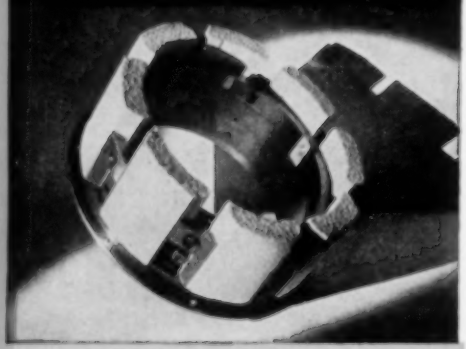
8-990

COMPRESSORS • AIR TOOLS
ROCK DRILLS • TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS
OIL & GAS ENGINES



ALUNDUM and CRYSTOLON
Segments are available for All Types of Chucks





Segment life doubled . . . Grinding time cut over an hour . . . *with the Sensational 32 ALUNDUM**

IN the plant of one of the largest producers of die castings they grind vanadium steel impression blocks on a Blanchard surface grinder equipped with a Norton chuck — removing about 3/32" of steel on each side. Segment life had been about three days per set.

When they changed to open structure segments of the new 32 ALUNDUM abrasive (32A24-F12VBEP) life jumped to *six days per set* and they save 1¼ hours grinding time on each block 24 x 24 x 6". And they report that the 32 ALUNDUM Segments are cooler cutting, too.

NORTON COMPANY • WORCESTER 6, MASS.
Distributors in All Principal Cities

*Trade-mark Reg. U. S. Pat. Off.

W-1104

NORTON CHUCKS
Are Easy to Use

No back-up blocks nor rings are necessary —just slip the segments in place, two at a time, and tighten the clamps between them. There are two quick adjustments for wear. Available for No. 16 and 18 Blanchard, 14" Pratt & Whitney and 20" Hanchett Grinders.

NORTON ABRASIVES

Compressed Air Magazine

COPYRIGHT 1947 BY COMPRESSED AIR MAGAZINE COMPANY

VOLUME 52 **April, 1947** NUMBER 4

G. W. MORRISON, *Publisher*

C. H. VIVIAN, *Editor* — J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* — J. J. KATARBA, *Advertising Mgr.*
A. W. LOOMIS, *Assistant Editor* — DON J. MAREK, *Advertising Sales*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E.C., 4.
F. A. MCLEAN, *Canada*, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

Milk for Half a Million—*R. G. Skerrett* 80
"Too Tough to Die"—*Hugh Keyes* 85
Radiant Heating—*C. H. Vivian* 90
Gas from Coal in the Ground 95
Insulation of Air Lines Saves $33,000 97
Britain Conserves Compressed Air to Save Fuel 98
Caliche Presents Excavating Difficulties 99
Editorials—Army Week—The Cross of Gold—Machinery and Jobs 100
This and That 101
Freezing Unit Facilitates Repair of Water Service Pipes 102
New Carbide Jackbit Promises Faster Drilling 102
Industrial Notes 103
Industrial Literature 106

ADVERTISING INDEX

American Air Filter Co., Inc. 26
American Brass Co., The 14
Bethlehem Steel Co. 24
Burke Electric Co. 8
Combustion Engineering Co. 13
Conrader Co., R. 30
Cook Mfg. Co., C. Lee 12
Coppus Engineering Corp. 32
Crane Co. 15
Dollinger Corp. 3
Eimco Corp., The 7
France Packing Co. 19
Garlock Packing Co., The 29
Goodrich Co., B. F. 22
Hercules Powder Co. 10
Hose Accessories Co. 30
Industrial Clutch Corp. 9
Ingersoll-Rand Co. ..... 5, 17, 25, 27, 3rd Cover
Johnson Corp., The 29
Koh-I-Noor Pencil Co. 31
Koppers Co., Inc. 6
Madison-Kipp Corp. 11
Maxim Silencer Co., The 31
New Jersey Meter Co. 31
Niagara Blower Co. 21
Nicholson & Co., W. H. 27
Norgren Co., C. A. 29
Norton Co. 18
Powell Co., The Wm. 23
Raybestos-Manhattan Inc. 33
Square D Co. 30
Texas Co., The ..... 2nd. Cover
Timken Roller Bearing Co. ..... 4th Cover
Victaulic Co. of America 20
Vogt Machine Co., Inc., Henry 28
Walworth Co. 4
Waukesha Motor Co. 16
Westinghouse Air Brake Co. 27

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit

Published by Compressed Air Magazine Co., G. W. MORRISON, *President*; C. H. VIVIAN, *Vice-President*; J. W. YOUNG, *Secretary-Treasurer*.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York 4, N. Y., L. H. GEYER, *Representative*.
Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index.

ON THE COVER

LOCATED near Concrete, Wash., the Baker River Power Development was built in 1924 and 1925 and began operating on November 19 of the latter year. The dam was originally 263 feet high, but was raised to 286 feet in 1927. It is 450 feet long at the crest and contains 125,000 cubic yards of concrete. The reservoir, Lake Shannon, is 10 miles long and averages a mile wide, and its shores are well timbered. Some of its water comes from snow-capped mountains more than 10,000 feet high. Lake Shannon is acclaimed as one place where fishing is fine and getting better each year, thanks to intensive stocking. Water flows from the reservoir to the powerhouse penstocks through a 22-foot tunnel 900 feet long, and thence to two generators of 24,300-hp. capacity.

•

IN THIS ISSUE

AS DESCRIBED in our first article, soil-and-moisture-free compressed air has supplanted mechanical means for agitating milk in the new Dairylea plant in New York and also performs many other services there. Our second article relates the story of Tombstone, Ariz., once celebrated for toughness but now a growing health resort. If you are thinking of building a home or any other structure, you may be interested in the description of radiant heating that begins on page 90.

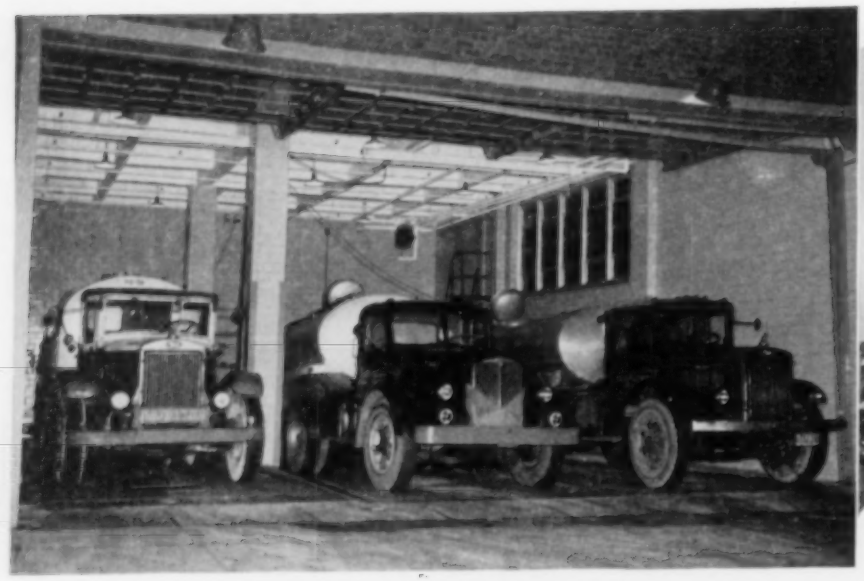
•

CONTRIBUTOR INCLUDED IN NOTABLE BIOGRAPHICAL WORK

A BIOGRAPHY of the late Paul Hoffman, who wrote three noteworthy articles for COMPRESSED AIR MAGAZINE a few years ago, appears in Volume 32 of *The National Cyclopaedia of American Biography*. Since 1890, the latter publication has, in its own words, "presented a continuing history of the United States as illustrated in the lives of the founders, builders, and defenders of the republic, and of the men and women who are doing the work and molding the thought of the present time."

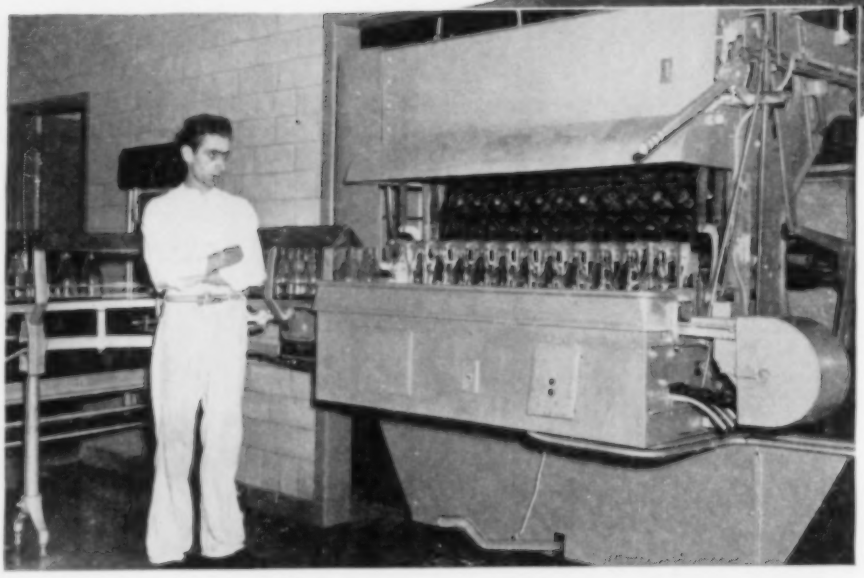
Born in Alsace-Lorraine and educated in Switzerland, Mr. Hoffman was employed in various engineering capacities by Ingersoll-Rand Company from 1911 until his death on September 11, 1943, at Easton, Pa. He was chief engineer of the Phillipsburg, N. J., manufacturing plant from 1934 until 1940, and consulting engineer thereafter.

Mr. Hoffman was the author of *Sidelights on Our Weights and Measures* in our February, 1940, issue, and of a 2-part article, *Supercharging Aircraft Engines*, that appeared in May and June 1943.



Milk for Half a Million

R. G. Skerrett



A NEW page was turned in the history of the wholesale milk-supply business of New York City during December gone when the Dairymen's League Cooperative Association formally opened its latest and largest processing and distributing plant on the west side of Manhattan. The occasion also marked the 25 years that have intervened since that progressive organization established itself on the east side of the Metropolis, where it might have remained had not the municipal authorities taken over the property for the development of the housing project now known as Stuyvesant Township.

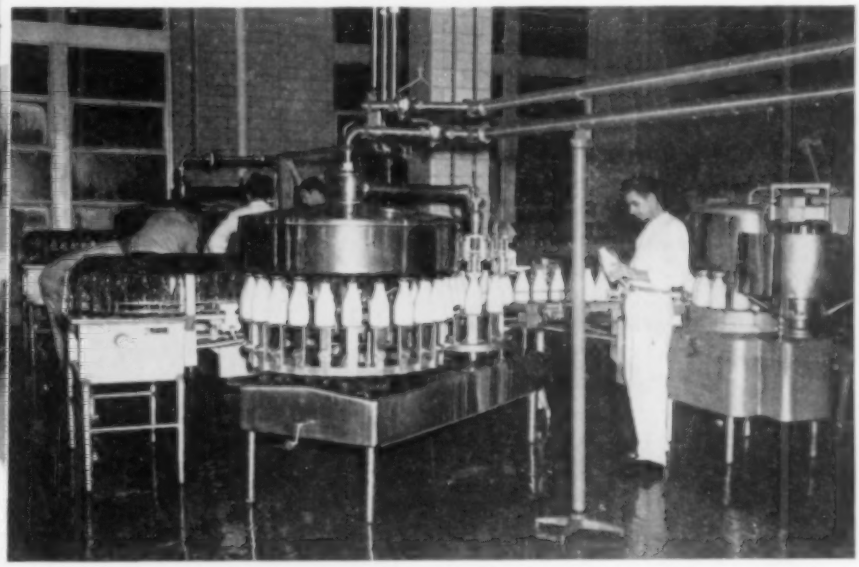
Faced with being dispossessed, the League sought an even more suitable area within the city for the erection of the new plant. It was found after a diligent 6-month search on the west side of Manhattan, between Forty-seventh and Forty-eighth streets and fronting on Twelfth Avenue, convenient to the milk depots of three railroads. Compared with the former establishment, the new plant is a striking advance architecturally and outstanding in its engineering features because the League has capitalized on its experience. Half a year was spent in completing the final plans and in preparing the specifications for the structure. There are ample evidences of this, and they all emphasize the importance of milk in the daily life of a community, especially in one having a large population.

Few New York City residents have but the faintest realization of how they are blessed and served in the matter of milk today, as against a century ago when the people within its gates numbered more than half a million and the population was increasing rapidly because of the influx of immigrants. The housing problem was acute, sanitary precautions and facilities were more or less primitive, most of the water available was still drawn from wells of doubtful purity, and the milk supply was obtained mainly from cows in the community. Those animals were fed on corn and rye mash from nearby breweries and distilleries and were generally watered from the tainted wells. The milk was "thin," of a bluish tinge, and woefully lacking in the constituents essential to body-building and the sustenance of young folk. As a result, there was a considerable period when the mortality rate among children up to five years of age reached the appalling maximum of 500 per 1000! Adolescents and grown-ups and invalids, too, probably paid toll for that milk in physical unfitness, susceptibility to disease, and in hastened death.

Not until the year preceding the celebration of our century of independence did the health authorities outlaw the sale of milk from mash-fed cows. Fortunately, farmers were finding ways and means to deliver milk from outlying districts in increasing quantities and so bring home to the people how much milk from country-fed cows would contribute to the well-being and growth of their young ones. Long after an ample supply was reaching New York from the far-flung milkshed, much of it was retailed in stores where it was ladled out from large open cans and poured into the customers' buckets or pitchers—an insanitary procedure that exposed the milk to dust, disease germs, and harmful bacteria. Milkmen who carted their com-

AROUND THE PLANT

The new tile-lined plant of the Dairymen's League Cooperative Association has a floor area of 1½ acres and can process milk for half a million persons. Adjoining the main building are quarters for the trucks that bring in 40 percent of the raw milk from six states and distribute it locally after bottling. Some of the tank trucks that transport raw milk from points as far away as 300 miles are shown at the extreme left. One of the several bottle-washing machines is illustrated on the opposite page. The bottles travel to it by conveyor and are scoured and sterilized at the rate of 9600 an hour. Then they go to a bottler (below), where they are filled at the rate of 8400 an hour. Human attention is required only for inspection and control. Another type of machine fills 4500 paper containers an hour.



modity direct to households also ladled it into open pitchers left overnight on doorsteps or at cellar entrances, where it was equally exposed to microörganisms and became a menace to health even though it was absolutely pure when it left its distant source. That method of handling "bulk milk" for retail consumption was permitted until 1934. We shall now be better qualified to evaluate what the Dairymen's League and allied organizations have since achieved for the commonweal.

The contract for the Twelfth Avenue plant was awarded to the Cauldwell-Wingate Company in August of 1945, at a time when building conditions were upset by the war and essential materials, skilled labor, and equipment were hard to get. But despite those difficulties it was erected and ready for its first test last November, shortly before the old structure on East Nineteenth Street had to be vacated. The new plant is, in effect, a milestone that marks how far the men responsible for it have advanced since 1922 in order that their facilities might subscribe in every way to present-day exacting sanitary regulations that are the outgrowth of long-pursued scientific research.

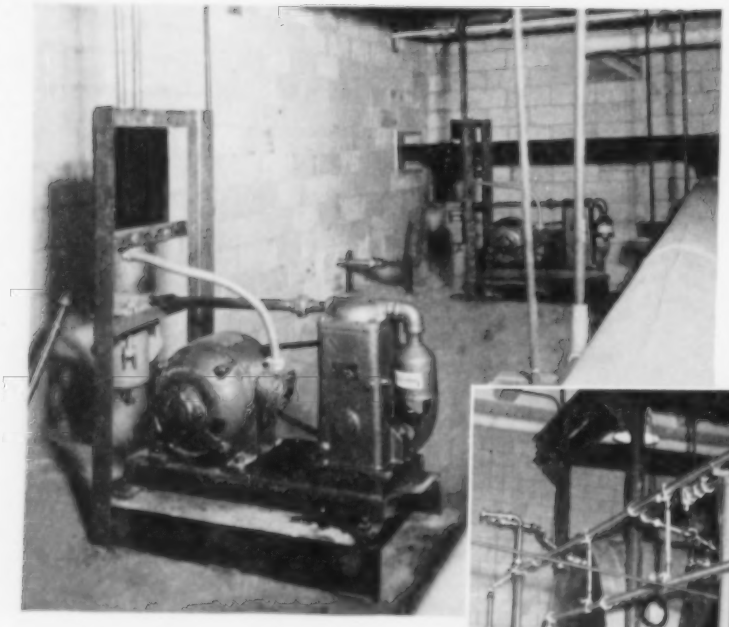
Because of its very nature, milk is much more susceptible to impairment than the majority of other foodstuffs grouped under the term "perishable." The potato, the apple, the ear of corn, and well-nigh every other fruit or vegetable has a skin or other covering that serves to protect it against deterioration or the attack of those things that break the envelope and make the food unfit for human use. Milk, on the other hand, is exposed to harmful atmospheric conditions and to air-borne bacteria and germs. It must be safeguarded from the moment it leaves the cow's udder until it reaches the pasteurizer and goes thence, under cover, to the bottling machine, where it is quickly placed in airtight, sealed containers for distribution. Even then, it has to be kept cool in warm weather and prevented from freezing in the wintertime.

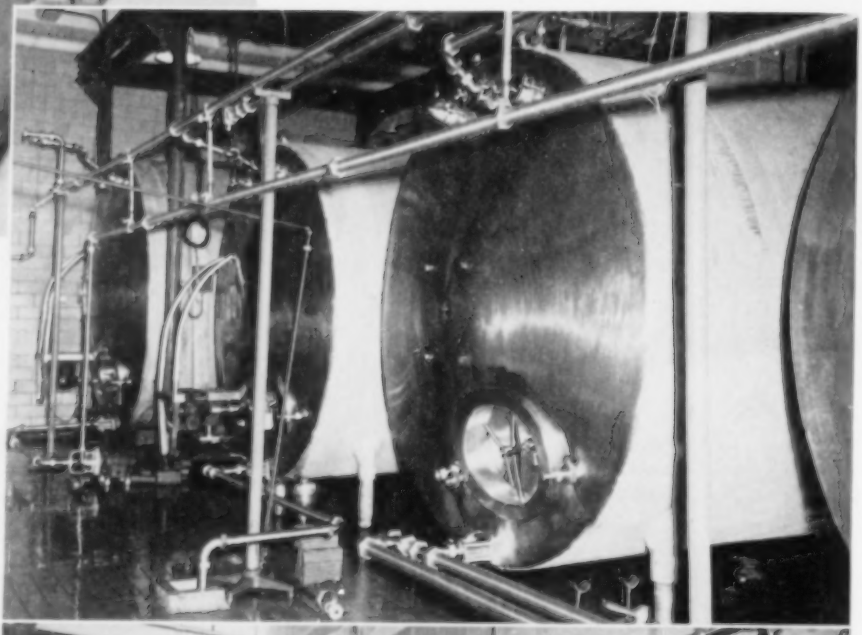
The milk handled in the plant comes from New Jersey, New York, Connecticut, Pennsylvania, Massachusetts, and Vermont, and arrives in stainless-steel or glass-lined tanks mounted on motor trucks or housed in specially built boxcars. Both are insulated so that no ice or other refrigerant is required to keep the contents cool while in transit. About 60 percent reaches the New York City market by railroad and 40 percent by truck. Traveling at speeds up to 40 miles an hour, trucks now move Dairylea milk an average distance of 207 miles, although some make 300-mile trips to and from the most remote parts of the milkshed.

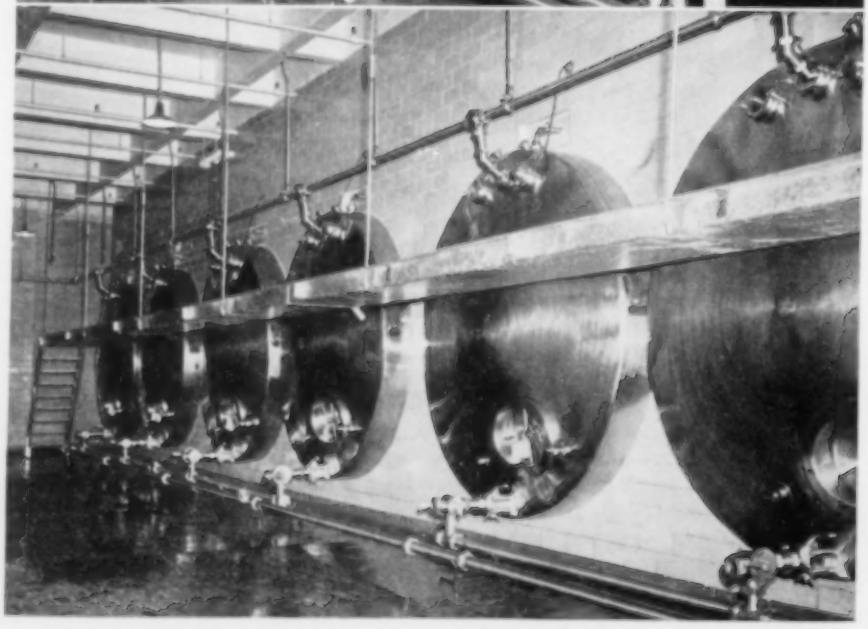
Upon reaching their destination, the tank cars are drained by compressed air or pumps that discharge the milk into tank trucks from which it is transferred directly to the plant's unloading room. Each of the glistening tank trucks holds 25,000 pounds of milk—the equivalent of about 11,619 quarts. Each evening, close to half a million pounds is pumped from some twenty trucks through stainless steel pipe lines up to the third floor, where there is an array of stainless-steel tanks having a total capacity of 430,000 pounds. All these tanks are 8 feet in diameter, but six of them are 20 feet long and two 10 feet. When the pumps have emptied the tank trucks, then compressed air is admitted to the pipe lines to blow out the fluid remaining in them. The milk arrives in the late afternoon or early evening, and the holding tanks are in service for a few hours each night and are the source of supply for the processing and bottling operations that are concluded in the early morning in time for delivery of the milk to the distributing agencies that carry it to thousands of consumers within the city's limits.

The milk division of the Department of Health of New York City prescribes that each bottle shall have an identical butterfat content—most of us call it cream—which, except in the case of homogenized milk, is found at the top of the bottle when it reaches the buyer. If it were similarly allowed to concentrate at the upper part of a storage tank and were not stirred continuously or at frequent intervals, the milk drawn off from the bottom of the tank would be deficient in butterfat. Therefore, to meet official requirements and to give every purchaser milk of equal richness, the fluid must be agitated.

Heretofore, it has been the common practice to do this by the use of power-driven impellers revolving horizontally







MILK-STORAGE TANKS

The bottom picture shows the discharge ends of six of the eight tanks in which raw milk is stored until it can be processed, while the one just below shows the rear ends of three of the holders. They are 8 feet in diameter and each has a capacity of either 7000 or 4000 gallons, depending upon whether it is 20 or 10 feet long. To prevent cream from rising to the top, the milk is continually agitated by liberating compressed air from a perforated pipe running through and along the tank bottom. To insure pure air, it is compressed in machines that operate without lubricating oil. On top of each holder is mounted an Ingersoll-Rand Type 30 Compressor, belt-driven by a 1-hp. motor. Two of these units are shown at the left. In this instance compressed air has replaced the traditional power-driven impellers.

at the lower ends of shafts actuated by electric motors mounted on top of each tank. This equipment has been generally satisfactory within the range of its effectiveness. The engineer, however, is ever on the alert for something that will do a job better, because he is continually faced with the problem of saving time or money. Notwithstanding the fact that the Dairymen's League plant has cost around $2,500,000, the organization's chief engineer, Amos Vroman, and the assistant chief engineer, Ralph E. Stork, have counted pennies wherever possible to insure compensating returns on the investment. Accordingly, those experts decided on compressed-air agitation for the raw milk in the storage tanks. The reasons for the change are thus explained by Mr. Stork:

"To assure the required agitation of the milk, the city health authorities would have insisted on an installation in each of the six 20-foot-long, 7000-gallon tanks of two impeller agitators, one near each end. Each impeller needs a 2-hp. motor to drive it, and two such units would add considerably to the time and labor required in getting into a tank to thoroughly clean it and its internal appurtenances after each day's use. This would necessitate removal of the impeller assemblies through the end manholes and reconnecting them after cleaning in readiness for the next operating period.

"It was then brought home to us that compressed air, as in other industrial operations, would do the work effectively without such complications as impellers, drive shafts, and packing at the stuffing boxes where the shafts pass through the tank shell to connect with electric motors. Instead of these moving parts, only a single perforated pipe has to be laid on the inner bottom surface of a tank from end to end and coupled to an air line leading up to a small compressor mounted on top of the tank. The agitator can be installed through the front manhole and removed for cleaning through the same passageway, thus doing away with operations at two manholes, one at each end of the tank. This enables one man to take the pipe out for daily cleaning and to replace it.

"Each of our holding tanks is provided with a 1-hp. motor driving a small special-purpose Ingersoll-Rand compressor of the NL Type, which is capable of supplying more than enough agitating air at sufficient pressure to meet maximum needs. Indeed, a ½-hp. machine of that class and make would be satisfactory, but on account of the war

these units were not obtainable. The cylinders of the NL machines do not require lubrication. This is particularly desirable where a foodstuff like milk is handled, because it prevents oil from getting into the air that is discharged into the milk during agitation. This end is obtained in the case of the NL cylinder by the use of a piston fitted with graphitic-carbon supporting rings which prevent metallic contact between the piston and the cylinder bore and which, because of their self-lubricating qualities, assure proper working of the compressor without the need of oil, grease, water, glycerine, or any other lubricant.

"Let me point out some of the other advantages inherent in compressed-air agitation. When mechanical agitators are employed, they are usually so installed that the distance between the lower part of the impellers and the bottom of a tank is from one-third to one-fourth of the diameter of the holder. Therefore, agitation is halted when the milk is withdrawn down to the level of the top of the blades so as to avoid stirring it at a rate that will induce objectionable foaming. As a result, a considerable quantity of the milk in the tank cannot be agitated during the final stage of emptying. On the other hand, with compressed air, the treatment can be maintained until the milk has been pumped off down to only 3 inches above the bottom of the tank. Stoppage is thus reduced to a very short period.

"Further, when a tankful is stirred mechanically and gently enough not to harm the milk, it takes approximately twenty minutes to distribute the butterfat uniformly throughout the entire volume. By actual test, we have found that air agitation will accomplish the same result in an interval of but 2½ minutes! The compressors for this service are equipped with an intake and a discharge filter, and after the air has passed through these two units it is clean and fit for the work and will carry no impurities upward in its passage through the milk. The compressed air is automatically vented from the top of the holder through a nonreturn valve to avoid building up pressure during agitation.

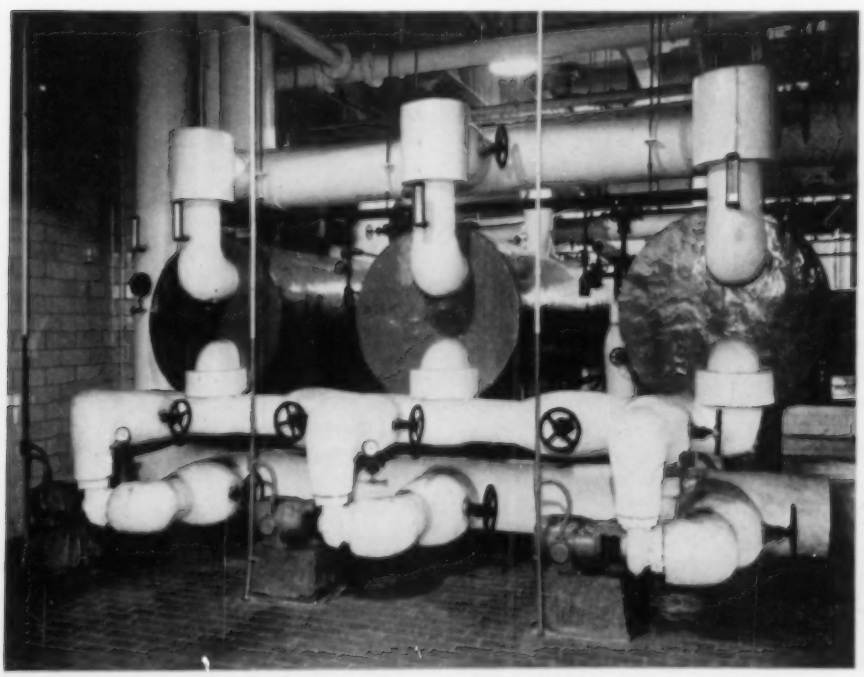
"Anyone familiar with elementary thermodynamics is aware that the expenditure of energy through mechanical motion tends to induce heat, and the greater the force exerted, the greater the amount of heat generated. With air agitation, we have a 1-hp. unit in action on each tank, with mechanical stirring we would need a total of 4 hp. for the two impellers required. In its dissipation, the heat might raise the temperature of the milk and possibly call for increased refrigeration to counteract it—introducing an added outlay. Plainly, agitating with compressed air is more efficient and also more economical."

From the storage tanks the raw milk is transferred by small electrically driven pumps to smaller stainless-steel tanks. These are the source of the milk that is delivered by three timing pumps to four DeLaval clarifiers, thence on to three Manton-Gaulin 2-stage homogenizers, and, finally, to short-time pasteurizing units. From the latter it is pumped to three balance tanks, each of 2000-gallon capacity, which feed the bottle-filling machines. Each balance tank has a 1-hp. NL compressor that keeps the milk agitated prior to bottling. The timing pumps mentioned are brought into play automatically the moment they are needed, a fact that indicates the intermeshing of succeeding operations which function well-nigh as if they were self-willed. Many of the controls are thermostatic and cause important valves to work automatically—the valves, themselves, actually being opened and closed by compressed air.

Pasteurization is accomplished by two methods. By one, the raw milk is brought up to a temperature of not less than 143°F., is held there for 30 minutes to kill the bacteria that promote souring, and is then cooled to something below 40°. The second one is the lately developed short-time pasteurizing process. This involves heating the milk to 163° and maintaining it at that temperature for only seventeen seconds, then cooling. Heating the milk in the pasteurizers to the required maximum is done by pumping hot water through banks or groups of horizontal plates, of special noncorrodible metal, between which the milk passes. During the cooling stage, the milk is similarly run between plates that are chilled by circulating brine by means of three Ingersoll-Rand pumps, each of which has a capacity of 275 gpm. under a 50-foot head. There are also three hot-water circulating pumps of the same make in the pasteurizing service. The valves controlling the brine and hot-water supplies, as well as the milk-control valve on each pasteurizer, are operated by compressed air and are governed by thermostats.

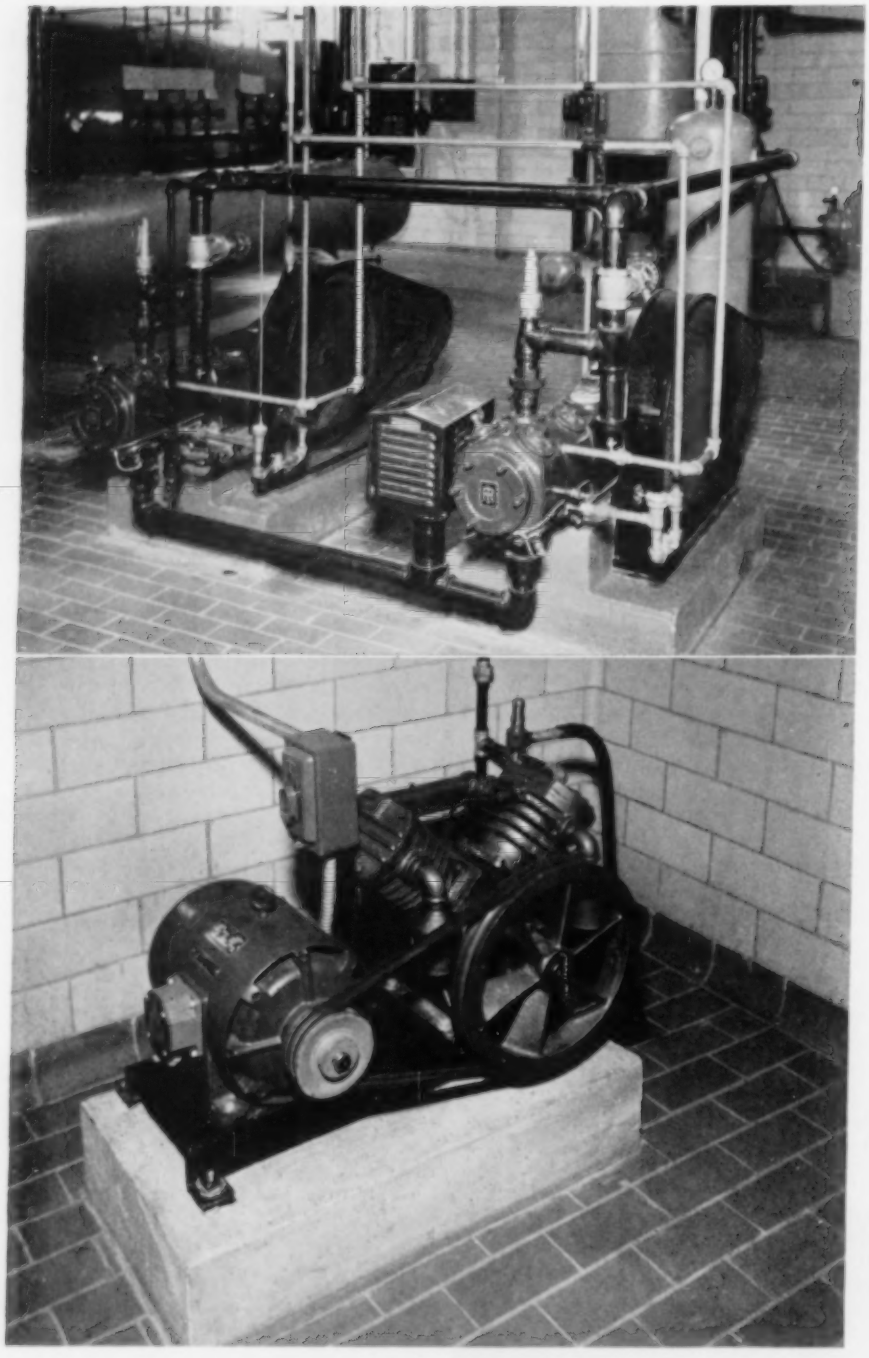
As in the case of milk agitation, it is essential that the air for the last-named purposes be free of oil and moisture, although for a different reason. Here the important thing is to eliminate extraneous substances that might clog the valves or otherwise prevent them from operating properly. Accordingly, this air supply is likewise obtained from nonlubricated compressors—from two Ingersoll-Rand Class ER units each rated at 40 cfm. at a pressure of 100 psi. Another compressor, a standard Type 30, furnishes air for a paper-container filling machine, for the fire-protection sprinkler system, and for other services.

The filling and bottling section of the plant is on the ground floor and in the southwestern corner of the building. Throughout this part of the structure the second floor has been omitted and there are wide windows in the west and south walls admitting an abundance of daylight to facilitate keeping the space scrupulously clean and to discourage the propagation of those germs and bacteria that thrive in dark and shaded places. In this department are six filling ma-



COOLING THE MILK

Following pasteurization, the milk is cooled to bottling temperature by passing it between plates of noncorrosive metal that are chilled by circulating brine. In the foreground are the three Ingersoll-Rand Motorpumps in that service. Each has a capacity of 275 gpm. against 50 feet of head.



OTHER COMPRESSORS

In addition to its use for agitating milk, oil-free compressed air is needed for operating valves on various pieces of equipment. This air is furnished by the two 40 cfm. "NL" (nonlubricated) compressors shown at the top. Air for paper-container filling machines, for the fire-protection sprinkler system, and for other services is supplied by a Type 30 compressor (bottom view).

chines: three, each capable of handling 140 quart bottles a minute, and three for filling paper containers at the rate of 75 quarts a minute. The latter are to be replaced later with larger units. A vacuum is automatically "pulled" on each bottle so as to draw the milk into it rapidly and without spilling. Final operations consist in firmly sealing each bottle with a cardboard disk and paper cap held snugly in place. When working at maximum capacity, the plant can handle 60,000 pounds of milk an hour—enough, so it is said, to supply half a million consumers daily. As one official expressed it: "If all the milk from one day's operation were put into bottles and the bottles were placed side by side they would make a line about a mile long."

Before any bottle—whether new or previously used—is put on the revolving platform of a filling machine, it is run through a cleaning machine where it is thoroughly laundered, sterilized, and dried ready to be placed on a conveyor system that carries it to the bottler. The washers clean and sterilize bottles at the rate of 400 or 500 a minute, the containers traveling to them also on a continuously moving conveyor. Conveyor systems perform a very important part in the operation of the plant, because they take the incoming bottles from the landing platform and transport them in the familiar wooden cases to the inspection department before they go to storage or directly to the washing machines. To arrest the movement of the cases at certain stations there are air-operated brakes that instantly act to check them while the conveyor platform travels on beneath them. After the bottles are filled and sealed, they are packed in crates either for temporary holding in a chilled room or for delivery to the loading platform, from which trucks take them to the distributing substations.

In the by-products room on the third floor is equipment for handling buttermilk, chocolate milk, sour cream, sweet cream, and ice-cream mix, as well as facilities for separating the cream from the milk and for making butter. Some of these commodities are thick and will not flow freely, so compressed air is used to force them down to the fillers on the first floor. Pressure is applied directly to the fluids in the tanks, each of which has a capacity of 500 gallons. There are four tanks for processing ice-cream mix, and these are equipped with power-driven impellers because of the vicosity of the mixture.

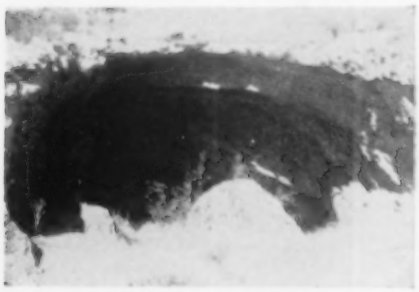
All operations are carried on in accordance with a highly systematized daily and seasonal schedule; and because of the mechanical equipment and the extensive use of compressed air, the total working force numbers only 270. Most of the employees are on duty in the daytime and are engaged in thoroughly cleansing all parts not only of the plant directly involved in the various processing operations but of every tank, pump, or other milk-handling machine. These activities are under the supervision of Harold Orr, the plant manager.

Adjoining the main plant is a 2-story garage of matching design in which are serviced the big tank trucks, including those that bring in the raw milk from the widespread milkshed, the Manhattan branch tank trucks that haul the milk from the tank cars arriving at the tributary railroad stations, and those that do the necessary distributing within the borough. Compressed air is used in many ways in the garage and is provided by units installed in the engine room in the basement of the main building.

The up-to-date plant at Twelfth Avenue was financed by the 26,000 active dairymen who are members of the Dairymen's League Cooperative Association.

"Too tough to die"

Hugh Keyes



OLD MINE OPENING

Now just a hole in the ground, this was once the portal to a silver treasure trove so rich that it was called the "Million-Dollar Stope." It is located only a few blocks from the center of the town.

ED SCHIEFFELIN was born in Oregon, and as he grew older there developed within his heart a burning desire to prospect—a desire that was to bring him both fame and riches. Some people say that it was fate; others say it was just plain luck that led the adventurous Schieffelin in 1877 to the Apache-infested Arizona Territory, where he stumbled upon one of the earth's richest deposits of high-grade silver ore and where he founded the town of Tombstone.

After reaching Arizona, Schieffelin joined the forces of the celebrated Indian fighter Al Sieber and served for many months as an Indian scout. The troops made their headquarters at Camp Huachuca, a newly established army outpost in the southeastern part of the Territory, and hunted for the murderous Apaches in an easterly direction across the San Pedro Valley where there were miles and miles of rolling, barren, mesquite-covered hills that offered no reward of riches if a person were content merely to look upon their dreary slopes. Centuries before, the Spanish conquistadors had crossed this same area, never dreaming that they were passing up the silver for which they were searching. Mexican smugglers had ranged over the hills for decades, camping in the narrow draws but never once giving thought to their possible wealth.

Riding over this drab region one afternoon came the soldiers at breakneck speed to overtake a band of Apaches. Suddenly, the gleam of mineral streaks in a pile of rocks caught Schieffelin's eye. Reining his pony to a stop he picked up some pieces and examined them with deliberation. It took several minutes for the realization to strike him that the float was veined with silver, rich silver! He smiled, as his thoughts immediately began to build castles in the air. When the hunt was over he would quit his job as scout and look for the wealth he knew was hidden in those colorless hills. Dropping the rock into his pocket, he rejoined his comrades.

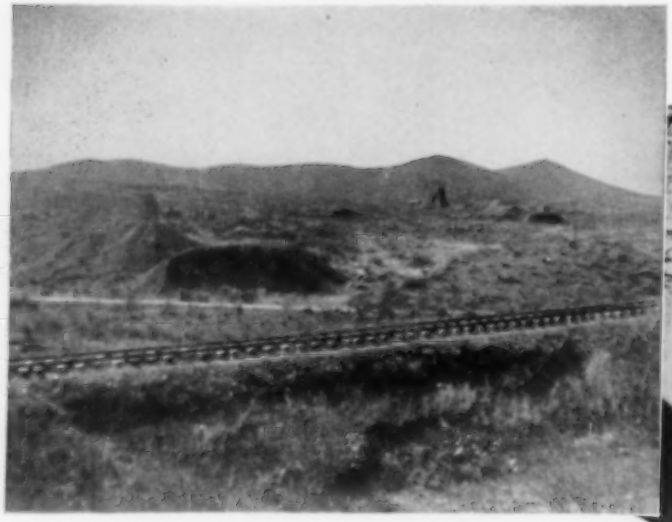
After weeks of riding and fighting with the Indians, the soldiers returned to their headquarters, where Schieffelin lost no time in handing in his resignation. Leaving the camp, he stayed for a while with a man named George Woolfolk. Each day he would wander into the hills until, at last, he found the exact spot where he had picked up the float. But discouragement followed. Weeks turned into months, and still he was unable to locate the source from which the ore had drifted.

Finally, he joined a group that was working the old Brunckow Mine and was persuaded to stand guard against Indian attacks while the miners toiled in the deep shaft. It was there that his former boss, Al Sieber, found him one day sitting in the doorway with his rifle across his knees. "What are you doing here, Schieffelin?" queried the famous scout. Ed looked up slowly and answered, "Prospecting in them hills over there, why?" "There ain't nothin' in them hills, Schieffelin. The only thing you'll ever find there'll be your tombstone," snapped back Sieber, as he spat on the ground and spurred his pony on. "Find my tombstone, will I?" sneered Schieffelin, "we'll see about that." He was worried a little about the prediction but was not ready to give up his search.

When there was no longer any use for him at the Brunckow, Ed wandered out into the hills again, this time determined to discover the mother lode. Coming around the bend in a wash late one afternoon he spied something white. It could be many things. Perhaps the bleached bones of some animal that had fallen victim to the twin demons of the Arizona Territory, thirst and heat. But when Schieffelin stepped closer he was shocked at what he saw. Two human skeletons were lying outstretched, face downward, on opposite sides of a pile of rocks, mute evidence of their fate. An Apache raid, perhaps, had sent them over the Great Divide just as they were rejoicing over their rich find. Ed examined the stones

PEACEFUL AND QUIET

The lawlessness that gave Tombstone its great notoriety lives only in memory. The desert sun beats down on a sprawling community of buildings and automobile trailers where life flows easily and uneventfully for citizens, tourists, and health seekers.



RELICS OF A MINING HEYDAY

About all that remains of Tombstone's once flourishing mines is shown at the top-left. Headframes and other surface structures have all but disappeared, and even a good part of the old dumps has been run through flotation mills or shipped out to smelters in recent years. As lately as 1934, Tombstone produced more than 100,000 ounces of silver, and in the following year its mineral output had a value of $413,970. It dropped to $271,580 in 1936, and in 1938 the Toughnut Mine belied its name and suspended operations. Thereafter, the Bunker Hill group and the Tombstone Extension Mine were the principal producers, on a declining basis, with lessees stripping the last paying ore from underground and old dumps contributing mill dirt. By 1944 output had dropped to 1255 tons, mostly from the Tombstone Extension Mine. Although Tombstone started as a silver camp, it yielded gold and lead in considerable quantities. Mementos of its former glory are the old ore wagons in which, during the 1880's, ore was hauled by 20-mule teams to a smelter at Charleston, about 10 miles away.

and discovered that they were like those he had picked up on the scouting trip. If he could trace them to their source, his fortune would be made. He replaced the rocks to stand forever as a monument to those two souls.

Taking up his journey into the wash, dusk overtook Ed. To fix a landmark by which to return the following day he climbed to the crest of a knoll. No sooner had he reached the top to take his bearings than he dropped to his knees, for a dusky, turbaned Apache was riding nearby. Schieffelin found a narrow crack between two huge boulders and crept into it, hardly daring to breathe. Cautiously he peered out and saw still another painted son of the Arizona desert. He crooked his thumb over the trigger of his rifle and raised it slowly, ready to fire into the ever-increasing number of ugly warriors.

Moments of suspense passed during which Ed thought of Sieber's warning, "You'll find nothin' in them hills but your tombstone." He was set to pull the trigger when the leader beckoned the band to leave. Schieffelin sighed with relief. Then, suddenly, there was a low outcry. One of the bucks had seen his tracks, and the Apaches were starting back to find the white man who was intruding on their land. He watched them pointing along the course he had taken. Some were dismounting, others were already creeping up the knoll. Just as he had given up hope for the second time, with the feeling that fate had swindled him, he saw the leader wave his arm once more and the Indians scurry back to their ponies and race away. Night was sacred to the Apache. It was the time of the dead, and darkness was falling fast.

Stillness returned to the valley, but Ed continued to crouch among the boulders, fighting off sleep until the sun rose and there was no sign of a redman. Although still badly frightened, he did not once think of abandoning his search. All morning he wandered among the rocks and brush, keeping careful outlook for any Indian that might have come back to kill him. Finally, near the head of the wash, he spied a ledge, and then all thoughts of Indians left his mind. What he saw took his breath away. Here before him was a vein that was crossed, recrossed, streaked, and splotched with silver! His hunch had been right, here was the fortune he had been seeking for so many months. The silver was so pure, so soft that it took the imprint of a quarter Schieffelin pressed against it. "Find my tombstone, will I?" he chuckled. Perhaps this was it, maybe this silver was to be his epitaph. The idea of calling his million-dollar discovery Tombstone flashed through his mind in a moment of pride!

Before long the world knew that Ed Schieffelin had found a "gold mine" of silver. New strikes were soon made in the vicinity, and a mining camp sprang up that was destined to make history.

SCHIEFFELIN'S TOMBSTONE

After Ed Schieffelin died in Oregon on May 19, 1897, his body was shipped back to Tombstone and buried, in accordance with his wishes, in prospector's clothes and with his canteen by its side. Over it was built a cairn (right) emblematic of the discovery monument sometimes used by prospectors to mark mineral claims. The inscription on the pile acclaims Schieffelin as "A dutiful son, a faithful husband, a kind brother, a true friend." Another monument to Tombstone's founder is Schieffelin Hall, shown above. In the years immediately following its erection in 1882 it was reputedly the most famous theater between San Antonio, Tex., and San Francisco, Calif.

It continued to grow until at one time it was larger than San Francisco, which was then in its toddling infancy. Huge caravans from the East, West, North, and South converged upon Tombstone, where everybody was rich. Many pioneers, with visions of wealth and luxury, poured their life's savings into diggings for the gleaming substance. The wild, untamed Southwest was good to some, but only very few of the thousands that looked for silver were ever rewarded to any great extent. Many were killed when they struck ore, and their claims were stolen. Today, you can go 20 miles in any direction from Tombstone and see the shallow prospecting holes that pock-mark the countryside. Into those diggings went the sweat, the tears, and the blood of many of the dauntless men who sought quick riches under the hot Arizona sun.

Some of the mines in the Tombstone area that are connected with Ed Schieffelin are the Contention, The Lucky Cuss, Tought Nut, Good Enough, East Side, West Side, and many others. How certain of them got their names is interesting. This applies particularly to the Contention, which was discovered by two prospectors, Williams and Friday. One night their mules broke away, and in searching for them they found bright metal which had been churned up by a chain fastened to one of the creatures. The trail led directly to the Schieffelin property, and naturally a heated dispute arose as to ownership. The argument was finally settled by splitting the strike. Ed took the lower half, which he called the Contention, and Williams and Friday took the upper, which became the Grand Central. The latter soon proved to be the richest find ever made in Tombstone. The name Lucky Cuss also has a story attached to it. Schieffelin was riding home one evening after he had been prospecting and passed a friend who was returning from a deer hunt. Ed remarked as they passed that he had made another strike. His friend muttered, "Lucky Cuss." Then and there Schieffelin decided to call his new mine The Lucky Cuss.

As Tombstone grew, so did its reputation. Throughout the United States people were talking about the greatest of all boom towns—Tombstone, Ariz. Today, its roster of bad men is known to every school boy in the West and to every lover of adventure stories. Their names have been immortalized in fiction—their feuds, hates, and loves have been dramatized until those villains have become little less than idols to millions of readers. The history of Tombstone is really stranger than fiction, more interesting than any yarn that could be spun around a campfire even by the most loquacious of desert wanderers.

With its lack of law and order in the early days, the camp was a haven for men who were hiding from justice. The Earp-Clanton show-down gun fight in the closing hours of an October afternoon in the O.K. Corral is still one of the most famous encounters of its kind in the annals of the West. Doc Holliday, black-coated cold-blooded killer, sided with his friends, the Earps, against Frank McLowery and the Clanton brothers in a fight that lasted only three quarters of a minute but that saw from 20 to 30 shots fired, three men killed, and four badly wounded. The Earps and Holliday limped away from the lead-throwing fracas and were later acquitted.

Billy Breakenridge came to Tombstone a smiling, handsome youth whose warm friendly eyes caused many people to believe that he wouldn't last long when he was sworn in as a deputy sheriff in the rip-roaring town. Sheriff Johnny Behan gave Billy his first tough assignment when he ordered him to ride to San Simon Valley and collect taxes from Curly Bill and his confederation of outlaws that had never payed one cent in taxes to the Cochise County officials. It was a perilous task, but the youngster never hesitated as he headed toward his destination. As he rode along he had an idea which, though dangerous, might work.

When he entered the small mining town of Turkey Creek he walked into a smoke-filled bar where swarthy cowboys were playing poker. Breakenridge looked around and saw a dark-complexioned man at one of the tables. He walked over to him and said, "Curly Bill, I want to introduce myself. I'm Deputy Breakenridge and I want you to help me collect the taxes in this district." Curly Bill, notorious for killing men just for the fun of watching them die, looked up in amazement. A smile grew into a hearty laugh, and he said, "Young fella, you sure got a lot of nerve to walk in here and say a thing like that to me. I might have killed you before you even opened your mouth. I like men with guts and from now on you and me are going to be deputies together." A lifelong friendship was cemented right then and there, and every penny of the taxes was col-

TOMBSTONE TODAY

Once considered a good place to shun unless quick on the draw, Tombstone is now making a name as a health resort. Its bright, warm sun and dry air seem to benefit sufferers from arthritis, sinusitis, and other ailments. Tombstone's trailer camp (bottom)) is populated largely by health seekers, and a building that was once occupied by a bank (left) has been converted into a medical center and hospital. The old courthouse, a substantial structure of brick and stone (below), is being divided into apartments to alleviate a housing shortage. Of the four newspapers that were formerly published there, the lone survivor is the "Tombstone Epitaph," whose quarters are shown at the lower-left. Tombstone is in the southeastern corner of Arizona in Cochise County and about 20 miles north of Bisbee. Its altitude is 4550 feet and the 1940 census gave it a population of 822.

lected by orders from the outlaw leader.

John Slaughter was sheriff of turbulent Cochise County from 1886 to 1890, and during that 4-year period his escapades were numerous and varied. He dealt out justice with his pearl-handled forty-four. Following in the footsteps of the Earps, Slaughter is given credit for being the man who finally brought justice to Tombstone. Although there were many times during his term when he stared death in the face, he seems to have had some sixth sense that told him he was not born to be killed; that when his hour came he would die in bed. He often quieted the fears of his companions with that statement.

When Slaughter was 80 years old and retired on his huge ranch about 40 miles southeast of Tombstone, plans were made by some Mexicans to murder him. That was in 1921, long after peace and order had been established in the district—long after he had need to use his gun to protect himself and his property. On the night the deed was to be committed, he was sitting in a chair reading a newspaper. Suddenly, without reason, he threw the paper aside, walked into a darkened room, and curled his fingers around the butt of his gun. He had no justification for doing this; he had neither heard nor seen anything suspicious. The old-time, unaccountable warning that danger was lurking near had seized him. Despite his age and feebleness Slaughter was still a fighter. When he started towards the door to investigate, his wife threw her arms around him and forced him into a chair. That saved his life, for when the foreman heard a noise and went out to see what was wrong, he was shot. A few days later four Mexicans were arrested. They confessed the murder and admitted that they had

Welcome to Tombstone
AND BOOTHILL GRAVEYARD.
BURIED HERE ARE THE REMAINS OF
TOM MCLOWERY - FRANK MCLOWERY AND BILLIE CLANTON
KILLED IN EARP-CLANTON BATTLE SEPT 25TH 1881
DAN DOWD, RED SAMPLE, TEX HOWARD, BILL DeLANEY AND DAN KELLY
HANGED LEGALLY BY J.E.WARD SHERIFF FOR THE BISBEE MASSACRE MAR 8TH 1884
JOHN HEATH
M. R. PEEL
BILLY CLANTON, BILLIE ANNIE, INDIAN BILL, PIKE LYNCH, RED KRONAN, BLACK JACK, GRADY BROTHERS
MIKE NOONAN, CHINA MARY, JOHN HICKS

ADVERTISING THE PAST

Tombstone's most publicized section is its cemetery, which was a busy place in the 1880's. Motorists are greeted by a large signboard welcoming them to Tombstone and Boothill Graveyard, although we feel certain that this ambiguous introduction is not meant to be taken literally. Many persons died natural deaths in early-day Tombstone, but they didn't get their names on the signboard, which was reserved for those who succumbed to ropes or "lead poisoning." Headboards at the graves of some of those who shuffled off abruptly are illustrated. Tombstone's present law-abiding citizenry isn't touchy about the town's notorious past, which is looked upon as a drawing card for tourists. Even the school buses bear the slogan, "The Town Too Tough to Die."

planned to kill Slaughter. The old man died a natural death the following year.

There were many instances of street hangings in the early days of Tombstone. Perhaps one of the most striking was the lynching in 1884 of John Heath in the early hours of Washington's Birthday for perpetrating the Bisbee Massacre. Heath was to spend the rest of his life in prison, while his comrades in the infamous killings were to hang. A group of Bisbee men, dissatisfied with the jury's verdict, rode the 24 miles to Tombstone and, at the point of a gun, took Heath out of his cell, strung him up on a telegraph pole on Tough Nut Street, and left before half of the townspeople knew what had happened.

By 1900 the boom camp had lost its importance as a mining center. Underground rivers broke into the shafts, filling them with water that cannot be pumped out. The population greatly decreased. Once the largest metropolis between San Antonio and the West Coast, Tombstone ceased to be the mecca of the West. Gone were the days of rich silver strikes, the click of poker chips and the noise of faro tables, the bark of a pistol ending a dispute. But Tombstone won for itself the title, "The Town Too Tough To Die," and lives on as a memorial to its discoverer, Ed Schieffelin, who laughed at the statement, "You'll find your tombstone." Schieffelin died in 1897 in Oregon and, according to his wishes, was buried attired in his prospecting clothes, with his pick and canteen by his side, only a few miles from the center of the town. To mark forever the spot where he rests, there has been erected over his grave a towering structure of gray rocks—a prospector's monument.

Although Tombstone is in Arizona it retains its territorial status and is the only place in the state besides Prescott that appoints a marshall. Today the town is taking on new life. A medical center has been established there, and from all parts of the nation people suffering from arthritis, sinus trouble, and other illnesses are flocking there to regain their health under sunny Arizona skies. Trailer camps and hotels are doing a thriving business, and the erstwhile mining camp is making a name for itself as a health resort.

Radiant Heating

C. H. Vivian

A RECENT INSTALLATION

Pictures show the Van Syckle automotive sales and service establishment in Phillipsburg, N. J., which was built last year. Just above is one panel of the grid-pattern piping fabricated by welding and laid on a gravel base preparatory to pouring the concrete floor. Piping in the floor of a display room for new cars (top) is in coil form. An interior view of this room, as finished, is at the right, and a night view from outdoors at the center-right.

RADIANT heating, which was used by the Romans around the beginning of the Christian era and then "lost" for twenty centuries, is becoming increasingly popular, although still far from common. Radiant heat is heat that is borne by rays. If you step from shade into sunlight on a cool day you feel warmer, although the air about you is relatively cold. The body absorbs heat rays from the sun as long as their course is unobstructed, but when a cloud obscures the solar disk they are cut off. Similarly, if you stand near an open fire your body is warmed, but the sensation disappears if some object comes between you and the fire.

Radiant energy manifests itself in many forms of rays such as light rays, infrared rays, ultraviolet rays, X-rays, and heat rays. The principal difference among them is the wave length. All can be absorbed, reflected, or focused. When heat rays strike an object some of them are reflected at the same wave length while others are absorbed. They warm the surface, which then gives off radiant rays of a longer wave length than the original rays. It is because of these things that skiers at Sun Valley, Idaho, are comfortable in bathing suits. Some of the sun's heat rays are reflected from the snow; others are reradiated from the rocks that have been warmed by them.

In conventional heating systems most of the heat is circulated by convection. Air, warmed by radiators, or warm air introduced through registers, expands, is lightened, and rises, displacing colder air above. Thus movement of the air is involved. In a radiant-heating system hot water or steam is circulated through pipes embedded in the floor, walls, or ceiling. Heat is conducted to the exposed surface, then radiated to persons and objects. The rays, like light, pass through the air without disturbing it mechanically.

The theory of radiant heating concerns the physiology of the human body. The body manufactures more heat than it needs and must throw off the excess continually to function normally and healthfully, otherwise it is in a state of fever. Most of the body heat escapes through the skin, which dissipates it by convection (passage of air over skin and clothing), by radiation (transfer to surrounding cooler surfaces), by conduction (transfer to a chair on which a person sits), and by evaporation of moisture.

Additional small amounts are lost by evaporation in the respiratory tract and by excretions. It is desirable that your body cast off heat at the same rate that it is manufactured, but the manner in which the heat escapes determines whether or not you are comfortable. On a humid summer day you may lose most of your surplus heat by the evaporation of perspiration, but you will probably not feel refreshed.

The body of an average-sized adult of sedentary habits generates about 400 Btu's per hour. The proportion of this heat lost by evaporation and respiration differs with the temperature and area of the moist surfaces of the body; the temperature, movement, and humidity of the air; and also with the age, sex, and race of the individual. It will amount to approximately 70 Btu's per hour if the temperature of the air is 60°F., and 90 Btu's if it is 70°F. The remainder of the heat, approximately 300 to 320 Btu's, is given off by radiation and convection. The greatest comfort will result if about 190 Btu's are disposed of by radiation. This leaves around 120 Btu's to be dissipated by convection.

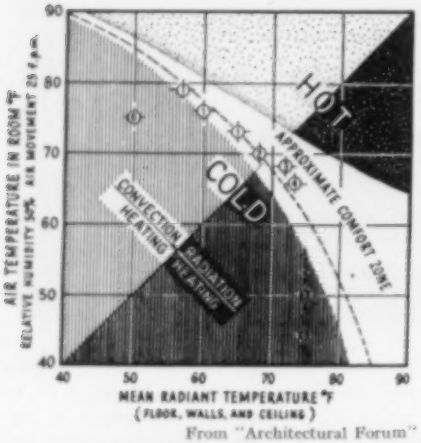
These proportions represent the optimum for comfort. Other ratios that will mean bodily ease under varying conditions are indicated on an accompanying chart. The Sun Valley skiers previously mentioned, being exposed to cool air and intense radiant energy from the sun, will lose practically all their heat by convection and none by radiation. On the other hand, a person in a room filled with warm air but having a cold floor and walls will lose heat chiefly by radiation. It is possible to eliminate the sensation of cold by heating either the air in the building, which is the conventional way, or some of the surrounding surfaces, which is the radiant-heating method. However, maximum comfort necessitates limiting the loss of heat from the body by radiation.

By way of illustrating this point, A. H. Barker, who is considered the modern discoverer of radiant heating, wrote as follows in 1932:* "If the walls of a room were uniformly at 75°F., no heat would be lost by radiation (assuming a normal skin and clothing temperature of 75°F.). In order to maintain the body comfort the air temperature would have to be about 44°F. so that the whole of the heat required to be abstracted from the body . . . . . should be removed by convection currents. Similarly, if the air of the room were at 75°F., no heat would be removed by convection and the surrounding walls would have to be at an average of about 50°F. in order that the whole of the surplus body heat might be dissipated by radiation alone. The former condition would produce a feeling of warmth and freshness. The latter would feel equally warm, but stuffy. The thermometer reading in the two cases would be widely different, though the feeling of warmth would be the same."

The foregoing paragraphs summarize the theory of radiant heating as expounded by researchers in the field of heating and ventilating and explain, in part, the growing interest in this branch of comfort engineering. Other reasons are found in the advantages claimed for it by its proponents. These have been set forth by Dr. F. E. Giesecke† as follows:

1. Radiators are out of sight and do not occupy floor space that can be used for other purposes.
2. When the structural frame of a building has been completed, the heating system also is in place and heating can be begun immediately to facilitate completion of interior work.
3. The heating system does not affect the location of partition walls or later changes of such walls.
4. When used in prisons or asylums, the system cannot be tampered with by the inmates.
5. The system can be used for cooling as well as for heating in localities where the humidity is not too high.
6. The floors are warmer than in buildings heated by ordinary systems and cold air currents along the floor are less intense.
7. Air currents within a room are materially reduced so that dust particles, to which disease-producing organisms may be attached, can settle out, thereby providing purer and more sanitary air.

*"Heating, Piping & Air Conditioning," March, 1932, page 208.
†"Heating, Piping & Air Conditioning," June, 1940.



From "Architectural Forum"

COMFORT CHART

To obtain approximate winter comfort, there must be a certain balance between air temperature and temperature of floor, walls, and ceiling. As this chart shows, a wide variation of conditions will suffice. The dotted line indicates the design-value for mean radiant temperature (average of floor, walls, and ceiling) at varying air temperatures. For example, if the air is 65°F., the mrt. should be 72°. The numbered points represent the values arrived at in tests and computations by the following: 1,1,1– American Society of Heating & Ventilating Engineers Laboratory; 2– Comfort Chart, American Society of Heating & Ventilating Engineers Guide; 3– Westinghouse Research Laboratory; 4– T. Napiar Adlam; 5 and 6,6– (English practice) L. J. Fowler and A. H. Barker.

RADIANT-HEATING SIDE LIGHTS

BECAUSE it makes wrought-iron pipe, A. M. Byers Company of Pittsburgh, Pa., has been intimately concerned with radiant heating in the United States since its inception. The following side lights on the subject appear in a comprehensive Byers booklet.

Radiant heating has been applied to just about every type of structure. It is in homes ranging in cost from $3000 to $75,000. It serves churches, industrial office buildings, hangars, garages, prisons, and taprooms. Unusual applications include:

A cathedral roof, where it prevents avalanches of snow from being precipitated on passersby. The reptile house in a zoo, and the "Monkey House" in the biological laboratory of a famous hospital. Industrial plants where the nature of the manufacturing processes makes concealment of all metal and minimizing of convection currents necessary for safety.

Some novel reasons for liking radiant heating have been reported by users, including a man whose furniture gets less abuse than formerly because his dogs now find the warm floor more comfortable to sleep on; a young couple who revel in the luxury of removing their shoes as well as their wraps when they enter the house; an employer who finds fewer creaking joints among elderly employees and whose clothes-pressing bills are lower than they were.

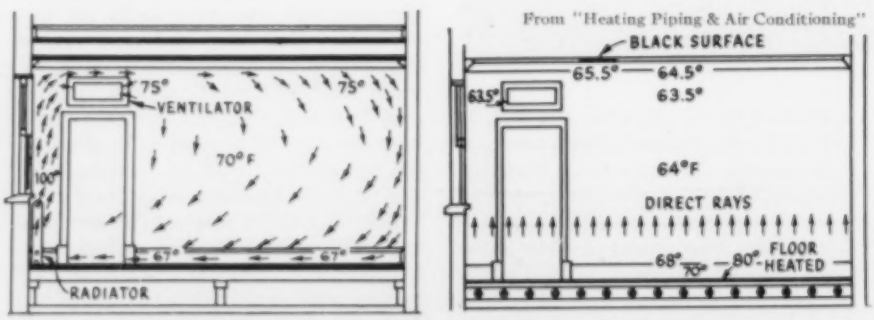
The Roman invaders who occupied England 2000 years ago circulated hot gases from charcoal fires through ducts to warm the walls and floors of buildings in Bath. The practice was discontinued for some reason, but the principle was rediscovered by Barker, a British inventor, about 45 years ago. Noticing that one room in his house was more comfortable than the others, although the temperature was the same in all of them, he sought the reason and concluded that it was so because one wall was warmed by furnace flues. He checked this theory by circulating hot water through pipes embedded in the walls of the other rooms and found that the result was equally comfortable conditions throughout the house. Since then, radiant heating has been applied to more than 1000 structures in the British Isles and France.

Some early installations made in the United States were probably inspired by the success of those abroad. In 1909, steam pipes were suspended between the floor joists of a 4-room, 2-story-and-basement school built in Glen Park, Ind., today a section of the City of Gary. The floors were of wood. In 1911, wrought-iron heating coils were placed behind steel plates in the walls of some of the rooms in a Baltimore clinic that is now a part of Johns Hopkins Hospital. The first sizable American radiant-heating system was put in a garage, built in Chicago in 1912, because the large number of doors made it difficult to use conventional radiators. Perhaps the first instance of residential radiant heating in this country dates back to about 1915 and involves a house near Schenectady, N. Y., in which heating coils were embedded in the concrete floor at ground level and placed in the second-floor ceiling. What is believed to be the initial public-building installation was made in 1928 when coils were laid in the concrete floor of a part of the Sacred Heart Church in Pittsburgh, Pa. Radiant heating was little more than a curiosity, however, until Frank Lloyd Wright made it a feature of the Johnson Wax Building in Racine, Wis. The publicity given that structure stimulated the interest that has led to a gradually increasing number of installations.

During the 1930's numerous small homes as well as industrial establishments were equipped with radiant-heating systems. The war stopped home construction, but there was an expanding use of radiant heating in other types of structures, a trend that has continued since the declaration of peace. The largest single plant to date is in a factory building erected during the past winter for A. O. Smith Corporation at Kankakee, Ill. The structure, which is mostly confined to ground level, has 415,000 square feet of floor space and will be heated by circulating water through 40 miles of piping embedded in the floors.

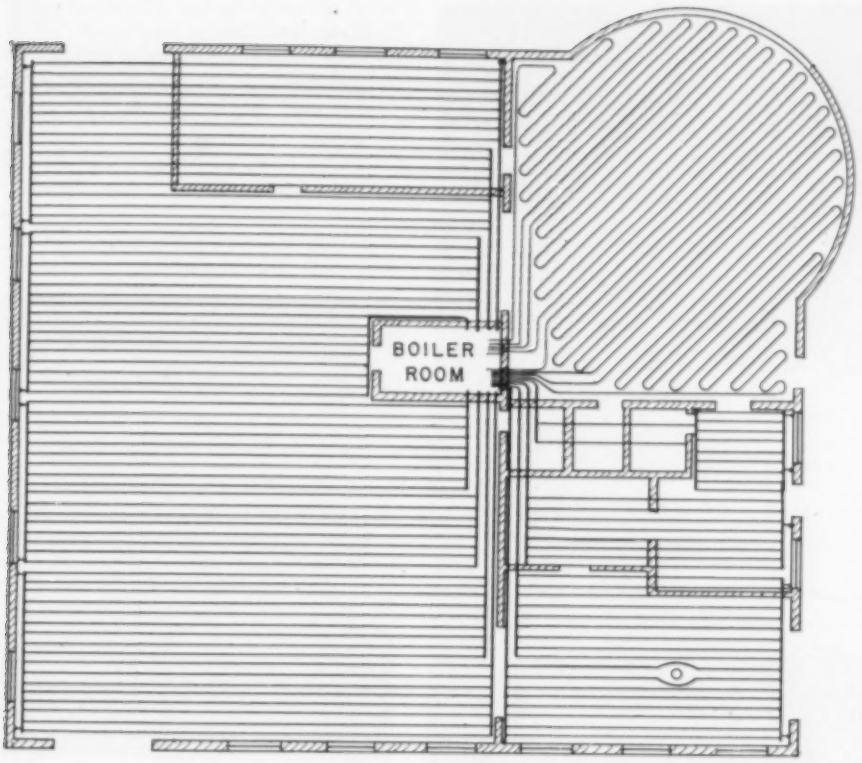
In buildings having large open areas, the floor is the logical place for the piping, and that is the prevailing tendency. Where there are partitions, as in homes, it can be placed in the walls just as well. Interior walls are usually selected because the heat will radiate both ways into spaces to be heated, whereas some of it will be lost if exterior walls are used. Two patterns of piping are favored, grid and coil, both of which are illustrated in an accompanying sketch. In the grid arrangement, lateral pipes are laid at right angles to larger feed pipes or headers. One unit of this kind is known as a panel, and the number of

From "Heating Piping & Air Conditioning"



CONVECTION AND RADIANT HEATING COMPARED

In a room 9 to 10 feet high and heated by a steam radiator, the temperature will be distributed somewhat as shown at the left. Air close to the ceiling will be about 8° warmer than that near the floor. With radiant heating under the floor, the distribution of temperature will be about as indicated at the right, with the air just below the ceiling cooler than that near the floor. Conventional heating gives rise to a "chimney" effect, with the warmer air tending to rise and escape through transoms and other openings to higher levels.



PIPING DIAGRAM

Floor plan of the Van Syckle building, which measures about 70x80 feet. Except in the area at the upper right, the grid system of piping is used. Approximately 5000 linear feet of 1-inch and 500 feet of 2-inch pipe (for headers) was laid, all of "Rayduct" wrought iron. Spacing is 1 foot throughout. There are twelve air vents in the grid panels, none in the coils.

panels depends, of course, upon the floor space. Each can be used independently of the others, making it possible to reduce or cut off the heat from any part of a building. In the coil type all the piping is of the same size.

Wrought-iron pipe predominates because it has good resistance to corrosion and its rate of expansion and contraction is approximately the same as that of concrete and plaster. This tends to maintain close contact between the pipe and the enveloping material, thereby promoting good heat transfer by conduction. It also minimizes cracking of the concrete or plaster. The usual range of pipe sizes is from 2 to 4 inches for headers and from 1 inch to 1½ inches for laterals and coils. Where smaller piping is required to fit into certain spaces, copper or copper-coated steel tubing is generally employed. Pipe spacing depends upon its size and upon the temperature and rate of circulation of the heating medium.

Either hot water or steam may be the heating medium, but the former is principally used. The temperature of the feed water is generally within the range of 125 to 140°F. The water is circulated by a centrifugal pump, and the desired heat is obtained either by regulating the temperature of the water or the rate of feed. An ingenious thermostatically actuated device mixes return water with hot water from the boiler to maintain the circulating temperature. In many installations a thermostat is located outdoors and controls mixing in accordance with the outside temperature. Thus, when a cold snap develops, additional heat is automatically fed through the piping system. In most cases the temperature difference between the feed and return water varies from 10 to 20°. Boilers are the same as those provided with conventional forced hot-water systems and may be fired by coal, oil, or gas.

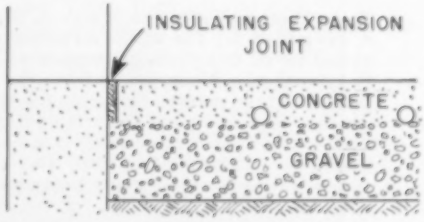
In embedding piping in concrete floors, the current practice is to lay a base of gravel or crushed stone, to place the piping on it and fabricate (weld) the system, and then pour the concrete. It makes little difference how much concrete is on top of the pipes because the heat will be conducted through it to the surface, although at a slower rate where the section is thick. Coverings of from 1½ to 6 or 7 inches have served successfully. The piping is generally laid level and can be blown out with compressed air if it becomes necessary at any time to drain the system. Although air vents are not considered essential in most instances, one is usually provided in each panel to guard against the possibility of air lock.

It has been found that spaces can generally be heated adequately if the floor-surface temperature is 85°F., maximum. It is claimed that at this temperature the floor is not uncomfortable to walk or stand on and that it is not harmful to commonly used rugs or other coverings and furniture. If higher surface temperatures have to be maintained, the pipes are usually put in the walls. Experience has revealed that the heat has no deleterious effect on paint or wallpaper. However, when wall panels are utilized, it is desirable to keep furnishings far enough away to permit good air circulation.

One of the virtues of radiant heating is the absence of heat "stacking." The convective currents created by conventional systems tend to dispose the heat in layers, with the warmest on top. The difference in temperature between the area near the ceiling and that just above the floor in rooms 9 to 10 feet high ordinarily ranges from 8 to 12°, depending upon the heating system employed. In a radiant-heated building, the difference is generally not more than 2°, regardless of whether the heating pipes are in the floor, walls, or ceiling. Measurements made in the Liverpool Cathedral in Liverpool, England, where floor panels are installed, disclosed a temperature difference of only 1½° between a point 4 feet above floor level and one at the triforium level, 93 feet higher.

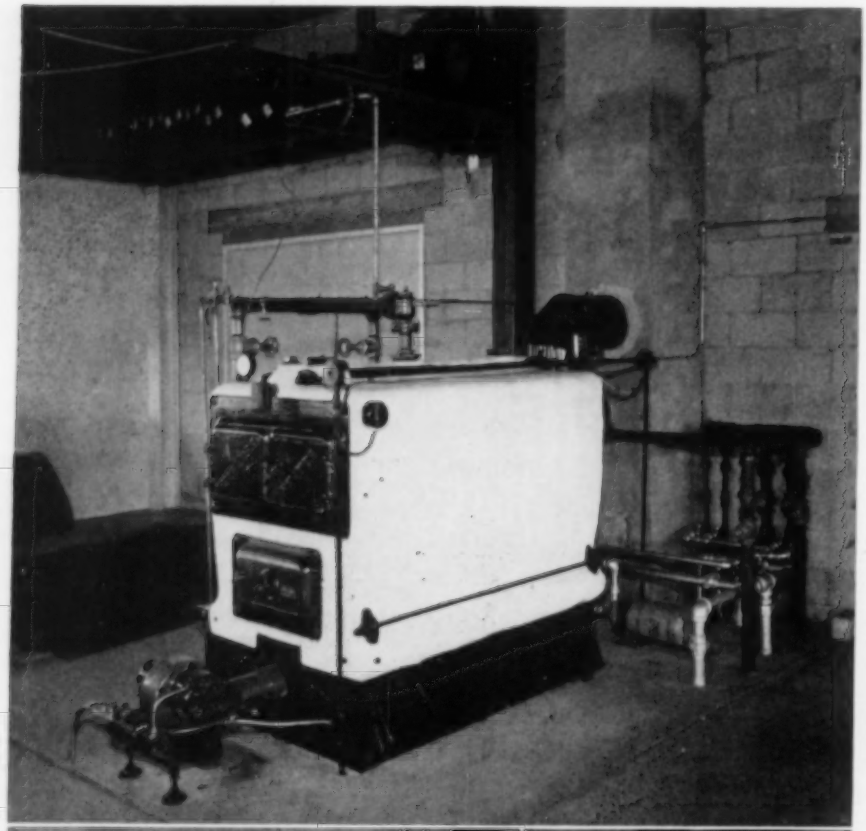
Greater cleanliness was listed earlier among the advantages claimed for radiant heating. Experiments have indicated that more dirt tends to collect on cool surfaces than warm ones, and this explains why there are no excessively dirty spots on the walls and ceilings of radiant-heated homes. That radiant heat is actually conducive to cleanliness can be determined by examining the wall around a conventional radiator. Soiled areas appear above the heating fixture, but the surface behind it is usually clean because that part of the wall is heated by radiant energy to a temperature higher than that of the passing air.

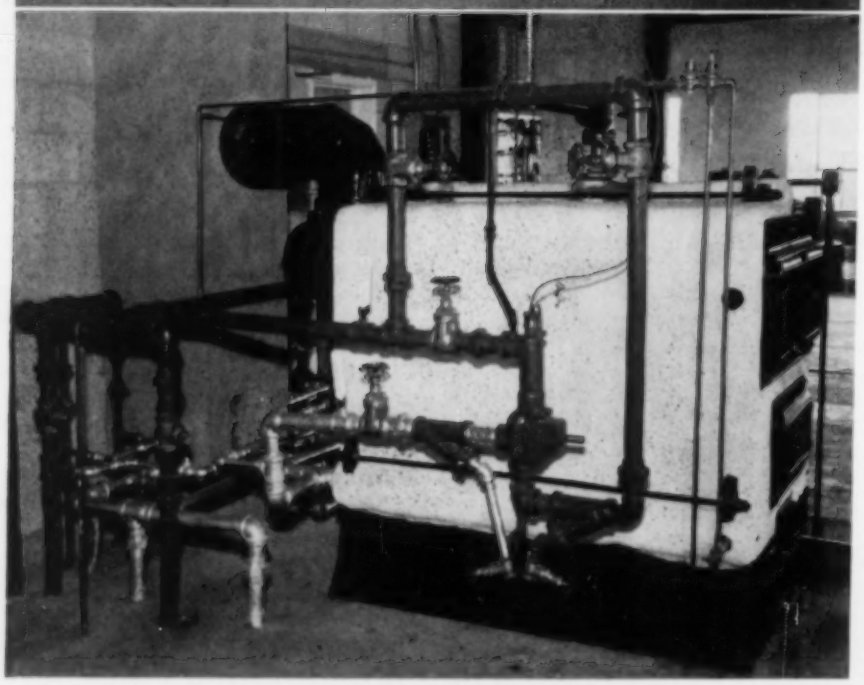
The first cost of a radiant-heating system is about the same as that of any other type. The operating cost is generally lower (30 percent is commonly claimed) for these reasons: (a) Comfort can be assured with air temperatures lower than those normally maintained—the expense involved in heating the air



SECTION THROUGH FLOOR

Piping was laid on a 6-inch base of river gravel on top of which was poured a 4-inch slab of concrete.





BOILER PLANT

These photographs of the heater in the Van Syckle building were taken before it was walled in. The unit is a Peerless, originally designed to burn coal but converted for oil firing. It is equipped with a Gilbert & Barker oil burner and uses No. 2 fuel oil. When the water in the closed circulating system is heated it expands, and the surplus flows into the tank shown above the heater in the view at the top. The maximum water temperature is 125°F. In the same picture, on the floor at the right of the heater, is the circulating pump, a Cameron 1-hp. Motorpump that can handle 50 gpm. This unit was originally bought for pumping oil and was pressed into service because of the difficulty of obtaining another one. A ½-hp. pump would suffice for the purpose. At the right of the pump may be seen part of the piping supplying the underfloor system. Valves and interconnecting smaller piping permit adjusting the flow of water to any section of the floor. The lower picture shows the "Sarco Therm" on the side of the heater that automatically determines what proportion of hot water from the heater is to be mixed with cooler water that has been circulated. It is controlled by a thermostat on the roof that makes adjustments in accordance with outdoor temperature changes.

CLOSE-UP OF PUMP

within the building is reduced proportionately; (b) there is less loss of heat through outside walls; (c) boiler temperatures are lower than in conventional heating systems and less fuel is used.

Accompanying illustrations pertain to a radiant-heating system in the Van Syckle automobile agency and filling station that was built in Phillipsburg, N. J., last fall. The single-story structure measures 70x80 feet. It is constructed of concrete blocks and its roof is supported by steel trusses. The piping, all of wrought iron, is in the floor. It was laid on 6 inches of river gravel of 1-inch maximum size, and 4 inches of concrete was poured on top of it. Most of the piping is of the grid pattern, coils being placed only under a circular car-display room that is approximately 35 feet in diameter and nearly half inclosed in glass. Details of the system are given in connection with the illustrations.

Radiant heating is well adapted to the needs of this kind of establishment, where large doors are opened frequently and where radiators would cut down the available working space. The heated floor slab quickly restores the temperature to normal after a car has been driven out, and the warm floor is comfortable for mechanics working under automobiles. During the past winter, which was for the most part abnormally warm for the area, it was seldom necessary to operate the heating plant after 10 o'clock in the morning. During the remainder of the day the floor slab gave off enough heat for comfort.

Gas from Coal in the Ground

Illustrations from
"Canadian Chemistry and Process Industries"

THE scarcity of coal in many parts of the world is spurring research in the possible underground conversion of coal into gas. The shortage of coal is in the consumers' bins rather than in the earth. There are plenty of deposits, but they aren't being mined in sufficient quantities to supply everybody. Last month we commented editorially on the experiment in gasification being conducted by the Alabama Power Company. Now we will deal with gasification developments in some other countries.

Russia has done more along this line than any other nation, but Belgium has made a start, and the British have seriously considered experimentation, as was brought out in reply to a question in the House of Commons a few weeks ago. An organization called Syndigaz was formed by Belgian industrial firms in 1944 to study the problem, and private and government funds totaling approximately $800,000 were made available for the purpose. The intention was to center efforts on two coal seams in the Liege field that were abandoned some years ago because of mining difficulties.

The coal measures in that section of Belgium are about 6600 feet thick and embrace 59 veins. Of these, only about twenty have been considered commercially workable under present conditions, and research in gasification was proposed with the idea of finding means of extracting the heat values of these otherwise unrecoverable deposits. If there have been any tangible results from the Belgian efforts, they have not been reported, and we must turn to Russia for information on actual operations.

The Russian activities are apparently sponsored by Premier Joseph Stalin, and were originally suggested by his predecessor, Vladimir Lenin, founder of the Soviet Republics. The first person to advance the idea of gasifying coal in the ground was probably Sir William Siemens of Great Britain, who wrote on the subject in 1868. Next to encourage it was Dmitri Mendelyeev, Russian chemist, who predicted in 1888 that it would come into general use. The first concrete method was suggested by an American, A. G. Betts, who took out a British patent in 1909. He proposed to drive a series of boreholes into a coal seam, to start a fire at the bottom, and then to introduce steam and air through one or more of the holes to drive the gas out by way of the others.

Actual experiments were not conducted, but in 1912 Sir William Ramsay, leading British chemist, talked on gasification twice and considered trying it at a Durham colliery. World War I broke out before he could put his plan into effect, and Ramsay died in 1916. Meanwhile Lenin, then living in exile in Cracow and earning a living as a journalist, heard of these various schemes and wrote an article for the newspaper *Pravda* in which he dodged the technical problems relating to the subject and waxed enthusiastic over the possibilities of gasification. Lenin died in 1924 without, so far as we know, fostering any practical work, but it is believed likely that he laid the groundwork for the extensive experimentation that was carried on in the 1931-33 period.

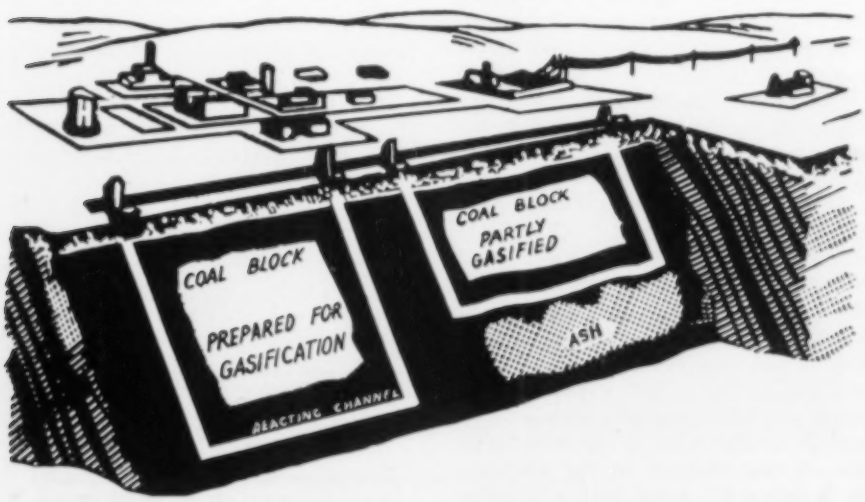
From what little has been written about this early research by the Russians, it is probable that by the method originally pursued the coal was broken up underground before gasification was attempted. Obviously, there could be little economic justification for such a procedure because it would cost almost as much as actually mining the coal, and one of the chief objects of gasification is to make the heat value of coal available without being obliged to do costly underground work. That the Russians found this out is indicated by the statement that "The present method and the present conditions of subterranean gasification were by no means obtained without difficulties, mistakes, disappointments, and without wastage of much creative effort."

The foregoing quotation is from a paper presented in Russia on December 7, 1943, by G. O. Nusinov, who had been concerned with the gasification efforts since 1936 and who had already written several books on the subject. His paper was translated during the war years by Dr. A. W. J. Dyck while he was on the staff of the Canadian Technical Information Service. It was published last June in *Canadian Chemistry and Process Industries*, and is the best source of information on the Russian activities that has so far come to our attention.

The preliminary work of 1931-33 resulted in the formation of an organization known as Podzemgaz which, by 1936, was reported to be employing 1500 persons, of whom 150 were scientists. Five sites for gas works were chosen in the Lower Moscow, Donetz, Kuznetsk (East Siberia), and North Caucasus coal fields. As a result of a technical conference in 1938 in connection with the 5-year plan, a series of industrial establishments was set up in the first three of these areas to utilize the gas from the coal for generating power and for operating chemical plants.

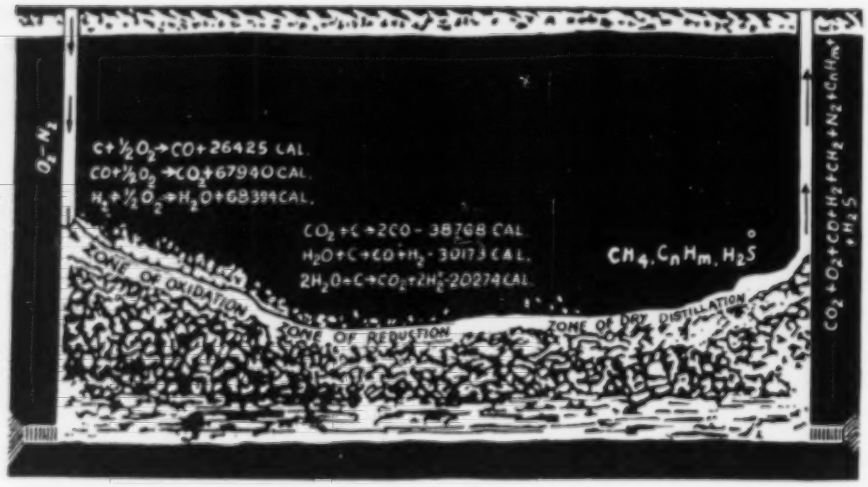
The coals selected for gasification vary greatly, but all of them are in deposits that cannot be mined profitably. They are either low in grade, exist in thin seams, dip steeply, tend to ignite spontaneously, are high in ash, or exhibit a combination of these disadvantages. Three principal methods of gasification have been proposed: the borehole-producer, the stream, and the percolation. The first of these envisions sinking two shafts, some distance apart, to the coal vein and interconnecting them at about 5-yard intervals with 4-inch-diameter holes bored through the coal. The idea is to light fires in groups of these boreholes in succession and then to send air, sometimes with steam added, down one shaft to force the gases up the other. This process, theoretically, burns a maximum of coal and is applicable to either horizontal or inclined seams. It does, however, necessitate considerable underground labor to excavate the boreholes.

The stream method calls for the sinking of two shafts, as before, and con-



TYPICAL RUSSIAN SET-UP

A panel that is being prepared for gasifying coal (left) is shown alongside one that has been in use for some time. The adjacent shafts are equipped with pipes through which air is sent down and generated gas reaches the surface.



PROGRESSIVE CHEMICAL REACTIONS

As incoming air meets the highly heated burning coal, the free oxygen combines with the carbon to form carbon monoxide, which almost immediately reacts with more oxygen to form carbon dioxide. At the point where the zone of oxidation ends—where all the oxygen has been consumed—the zone of reduction begins. There carbon dioxide reacts with the hot coal and is reduced to carbon monoxide. Water vapor from the coal is first reduced to water gas (carbon monoxide and hydrogen) and then reacts to form carbon dioxide and hydrogen. At this stage the generated gases are cracked and the zone of dry distillation starts. There the product is enriched by hydrogen, methane, water vapor, etc., and the resultant gas passes up the shaft to the surface. In general, the reactions are the same as those that take place when industrial gas is made above ground by passing steam over incandescent coke.

necting them at the bottom with a gallery, where the fire is started. This has apparently been found to be the most satisfactory procedure and will be discussed presently. The percolation system is similar to the scheme proposed by Betts in his original patent, and eliminates much of the preliminary work. Borings are made from the surface in concentric rings from 20 to 40 yards apart. Some of those in the inner ring are ignited first and air is forced down through them. In loose ground, the coal will burn along the seam to adjacent holes, from which the gas will emerge. Holes are lighted progressively, working gradually from the center outward.

Nusinov's paper deals with the stream method exclusively, indicating that it was adopted in preference to the others. An accompanying diagram shows how it has been applied to a steeply inclined coal seam. Dimensions of the shafts and gallery are not given, but it is understood that there is a panel of coal, containing around 11,000 to 12,000 tons, between each set of openings. As burning proceeds, there is considerable caving of the overlying rock and the underground cross channel assumes a chaotic shape, but it is stated that at no time does it become completely obstructed.

As is the case with gas made from coal in conventional retorts, underground gasification is effected in several stages. Near the point where the coal is ignited, adjacent to one shaft, is a zone of oxidation. Farther along the passage is a zone of reduction, and at the far end is a zone of dry distillation. The progressive chemical reactions that occur are indicated above. Maximum combustion takes place in the areas closest to the air shaft where oxygen is available and, as a result, there is a tendency towards uneven burning. To offset this somewhat it is the practice to reverse the direction of the air flow at regular intervals.

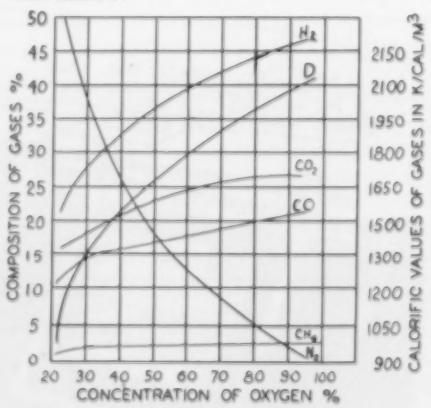
All gas produced up to the time the Nusinov paper was written was of low calorific value that could be considerably increased, however, by enriching the oxygen content of the air. At the Gorloff Station the gas had a rating of 93.2 Btu's per cubic foot when air was supplied, and of 191 Btu's when the proportion of oxygen was raised to 60 percent. This station operated for a year and a half, being interrupted by the German invasion, and produced approximately 2650 million cubic feet of gas, which was at first used for generating steam and later for heating retorts.

The gas obtained by introducing air alone was called "energetized" and was the principal product of the Gorloff Station. At the Lissichansk Station, on the other hand, a "technological" gas was made by adding oxygen to the feed. But in this instance the roof over the coal was strong so that it did not cave much and the channel remained open enough so that some of the entering air was carried through to the discharge shaft, where it burned with a considerable amount of the generator gas. As a result, the gas obtained with an input containing 50-60 percent oxygen had a heat value of only 120.2 Btu's per cubic foot. Eventually this difficulty was overcome by blasting down a part of the roof and by introducing backfill from the surface. This station ran from February to September, 1941, and produced 1410 million cubic feet of gas.

The Podmoskov Station encountered operating troubles in the form of open channels that permitted much of the air sent down the shaft to become dissipated. In consequence, various crevices had to be sealed with cement and clay. This station had generated 1060 million cubic feet of gas up to the time the Nusinov paper was prepared. When air alone was supplied, the gas had a heat value of from 89 to 101 Btu's per cubic foot. With the addition of 25-30 percent oxygen, it was increased to from 112.3 to 123.6 Btu's. Some of the gas was used in brickmaking plants.

The principal point of interest in connection with the Podmoskov Station, according to Nusinov, was "the development of a method that eliminated labor in driving the subterranean cross channel. After two shafts had been sunk to the layer of coal, air was forced down one of them under pressure. Diffusing through crevices and pores in the coal seam, it gradually burned out a channel extending to the bottom of the other shaft. The process of gasification then commenced in the usual manner."

Reports from Russia, all unverified and hence open to question, have at various times dealt with the economics of gasification in a general way. One claimed a recovery of 80 to 90 percent of the heat value of a coal bed, as compared with 60 percent by normal mining methods. Another, in 1941, indicated that only 15 percent of the labor force at a gasification station worked underground, as against 70 percent in coal mines. Production per man, measured in heat units, was said to be four times greater than when coal was mined.



EFFECT OF OXYGEN

Chart shows composition and calorific values of gases at various intake-oxygen concentrations. The curve *D* represents the combined gases produced. Values for them appear at the right and are stated in terms of kilocalories per cubic meter.

Insulation of Air Lines Saves $33,000

BECAUSE air expands when its temperature rises, a given quantity of compressed air can be made to do more work in an engine-type machine or tool if it is heated before it is used. Or, conversely, less free air or compressor capacity will be required to do the same work. This principle was well understood and applied even when the compressed-air industry was young. Half a century ago it was common practice to interpose heaters in air-delivery lines, placing them close to the tools so that a minimum amount of the heat imparted to the air would be lost before the latter was used. Prevention of freezing was the primary object, but power saving also was in mind. For various reasons, which will not be entered into here, reheating has been largely discontinued, although pneumatic engineers agree that it would still be advantageous for power-saving purposes in some applications.

When air is compressed, the work that is done on it is manifested in the form of heat. Theoretically, if air at 60°F. is adiabatically compressed to 100 psi. in one stage, it will be heated to 485°. If it is compressed in two stages with intercooling between stages, which is the usual procedure in industrial plants, it will be heated to 243°. Actually, variations of these theoretical temperatures occur in practice because some heat is carried off by the cylinder cooling water and some is lost by radiation. Final temperatures are, nevertheless, high. It is customary to lower them by passing the compressed air through aftercoolers, thereby condensing much of the contained moisture vapor and any oil that may have been picked up in the compressor. Consequently, by the time the air gets into the delivery mains, it is cool.

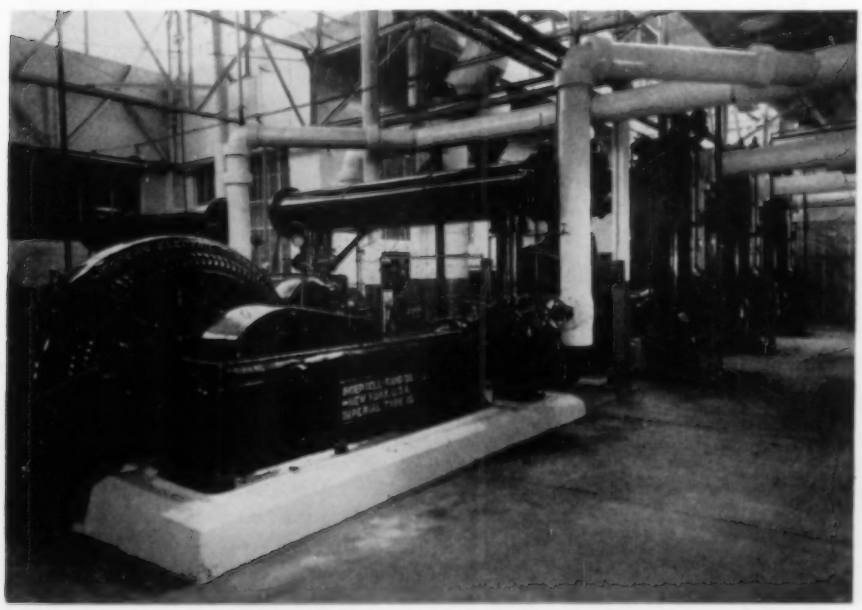
In most instances it is desirable to "aftercool" air to remove moisture, and for some applications this is mandatory. There are cases, however, where moisture is not detrimental, provided the temperature is high enough to keep it vaporized. Under such circumstances, retention of the heat offers a way of increasing the work that can be done with a given volume of free air. An instance of this kind came to light during the war at Merritton, Ont., Canada, where Hayes Steel Products Limited insulated the air-delivery lines serving its forge shop and thereby increased efficiency without adding to its compressor plant.

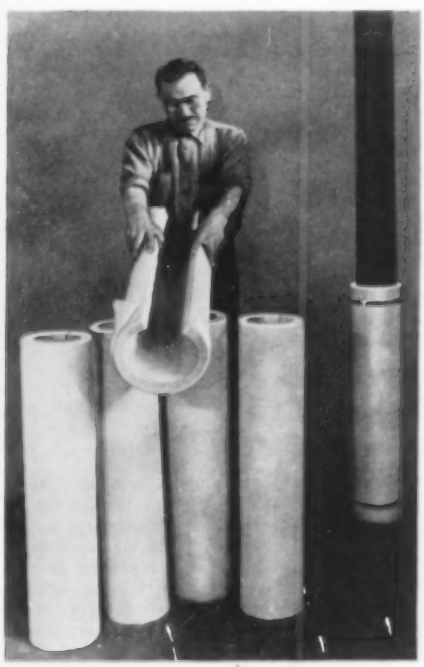
This concern was one of the first in Canada to adopt air power for operating forging hammers and experienced no difficulties under peacetime load. But when Canada prepared for war, the plant's activities mounted and it was expanded proportionately. Between July, 1939, and the height of operations, its employees increased from 350 to 1641 and its floor space from 75,000 square feet to 235,000. Tremendous amounts of forgings for vital battle equipment were produced, including 2,000,000 propeller shafts and universal-joint assemblies and more than 1,000,000 automotive clutches. The company was the first in the Dominion to make aluminum aircraft forgings in huge quantities.

In order to maintain a high production rate, it was necessary to take advantage of every possible means of saving time and increasing efficiency, and it was in this connection that a simple way was found to get more work out of the compressed-air supply. As ultimately built up, the shop is equipped with 21 forging hammers ranging in falling weight from 1200 to 12,000 pounds and totaling 84,900 pounds. The compressor plant houses six 600-hp. and two 300-hp. direct-connected electrically driven units with a combined delivery of 23,100 cfm. All discharge at 100 psi.

The forging hammers are in a separate building and are at an average distance of 500 feet from the compressors. The latter discharge into two outdoor air receivers that have a combined storage capacity of approximately 1035 cubic feet. From the receivers the air is delivered to the forge shop by two 10-inch overhead lines passing across an open yard where the temperature ranges from below zero in winter to 90°F. in summer. These mains have take-offs to the various hammers and terminate at a receiver having a capacity of 1105 cubic feet.

When the shop was carrying a heavy load, it was often impossible to maintain the desired air pressure at the hammers, and in cold weather there was a tendency for them to freeze because of the rapid expansion of the "unaftercooled" air in its passage through the hammer cylinders. With a view to insuring adequate pressure continually, consideration was given to installing another 600-hp. compressor. The use of aftercoolers





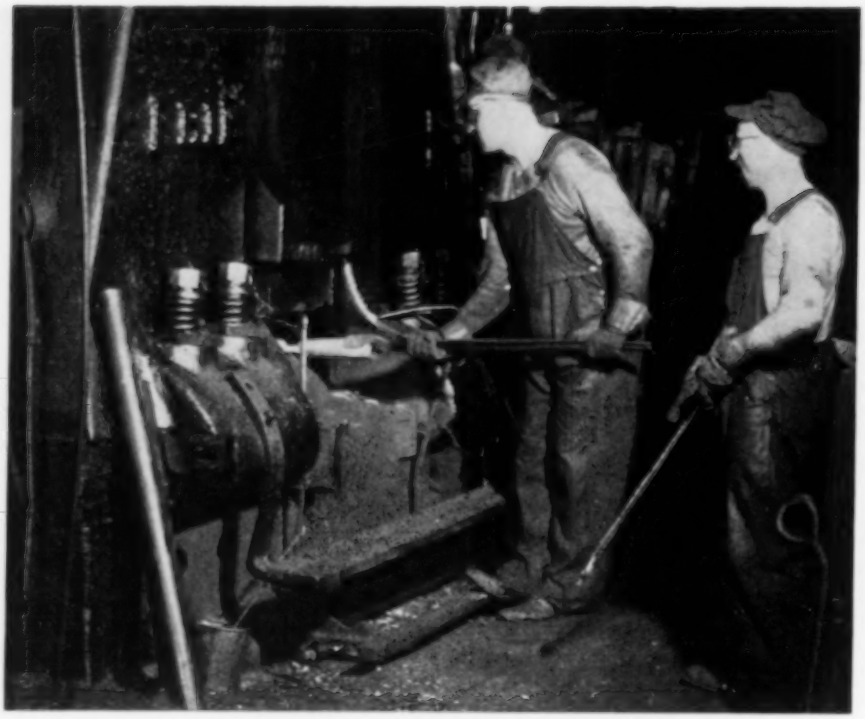
COMPRESSORS AND INSULATION

A partial view of the compressor plant (above), showing discharge lines lagged with asbestos so the air will retain the heat of compression. The insulating material is designed to withstand temperatures up to 700°F., as well as vibration and wear commonly encountered. The picture at the right illustrates how it is fabricated to facilitate placing it around the pipes.

to eliminate freezing also was considered. However, at that time there was a large backlog of unfilled compressor and aftercooler orders which would have occasioned a long delay in delivery.

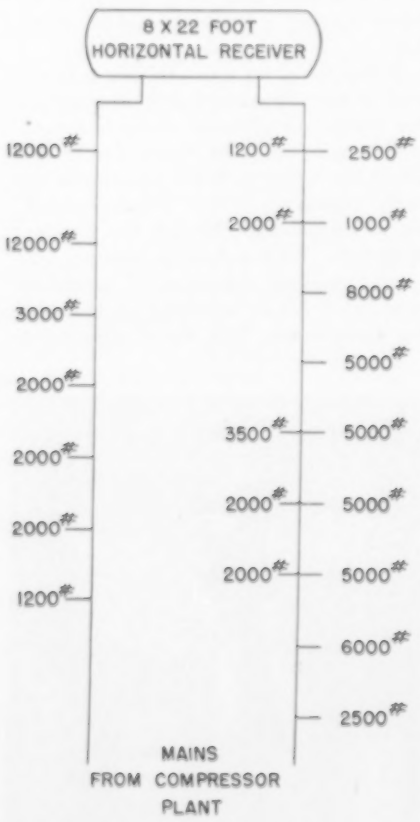
Because of the great urgency, a Canadian Ingersoll-Rand Company engineer made the suggestion that if the heat of compression lost by radiation could be retained in the air lines, the freezing troubles at the hammers would end and another compressor would probably not be needed. When Canadian Johns-Manville engineers stated that it would be practical and relatively inexpensive to insulate the air mains and receivers and that the job could be done immediately, it was decided to postpone the purchase of a compressor and aftercoolers. The insulation was applied and the results came up to expectations.

The entire compressed-air distribution system, including the receivers, was covered with Johns-Manville Asbesto-Sponge felted insulation 2 inches thick. The air leaves the compressors at an average temperature of 275°F. in winter and 290° in summer, and as it is not passed through aftercoolers it loses its heat only by radiation. With the piping so protected, it was found that the air reached the forge shop at an average temperature of 230°. Its volume was therefore considerably greater than it had been under previous conditions, and 95 pounds pressure could be maintained with 80 percent of the hammers working simultaneously.



ONE OF THE FORGING HAMMERS

Lagging the lines with asbestos cost approximately $2000; the 600-hp. compressor would have called for an outlay of $35,000. In addition, its annual operating cost would have been around $4000. Thus the problems of freezing and air shortage were overcome by a relatively insignificant expenditure. Production was speeded up immediately, instead of having to wait perhaps many months until new equipment could be obtained. Besides saving a considerable amount of money, another saving of even more importance to the war effort was effected because hard-to-get equipment was thus made available for service elsewhere.



FORGE-SHOP LAYOUT

The 21 hammers have a total falling weight of 84,900 pounds. Since the compressed-air delivery lines and receivers were insulated the air reaches the receiver end of the forge shop at a temperature of 230°F., winter and summer. The temperature drop in traveling more than 500 feet from the compressors averages 50°.

Britain Conserves Compressed Air to Save Fuel

THE plight of England during the recent fuel crisis and coincidental unusually cold weather has been extensively reported in the daily press. Actually, the British Isles, normally a heavy exporter of coal, have been hard pressed for fuel since the war began. During that critical period, the Ministry of Fuel and Power endeavored in every possible way to promote the conservation of coal. Among the steps taken was the publication of 47 bulletins that were designed to inform the population how to save fuel.

One of these, No. 29, is entitled *The Industrial Use of Compressed Air.* It stresses the importance of preventing leakage and points out what this means in terms of fuel conservation. "It should be remembered," it states, "that 64 leaks each equivalent to a $\frac{1}{16}$-inch-diameter hole are together equal to one leak through a hole ½ inch in diameter. This number of leaks is by no means an impossible occurrence in large installations." In a system carrying 100 pounds pressure, the escape of air through 64 openings of that size would represent 25,000 cubic feet per hour and, in a year's time, a wastage of 128 tons of coal. The figures are based on the use of electrically driven compressors of high efficiency.

The pamphlet also discusses the following subjects: How to test for leaks; importance of filtering intake air to keep dirt out of compressors; avoiding trouble and conserving power consumption by guarding against overlubrication; importance of eliminating surplus moisture from compressed air by aftercooling; providing adequate air-receiver capacity to smooth out variations in demand; proper attention to laying out air-delivery lines to reduce frictional losses and the inclusion of moisture traps; and proper installation of air compressors, with particular attention to insuring a cool air supply and operating the cooling water system efficiently and without wasting water. A separate section deals with maintenance of compressors, tools, and air lines, and an appendix gives formulas for working out the desirable sizes of delivery pipes. In the interest of conservation, the booklet is distributed free to compressed-air users.

Caliche Presents Excavating Difficulties

COMBATING CALICHE

Above is pictured the special tool fitting that was made up so as to be able to drive rods into the resistant ground with a paving breaker. The view at the right shows caliche-cemented fill material after it had been broken up.

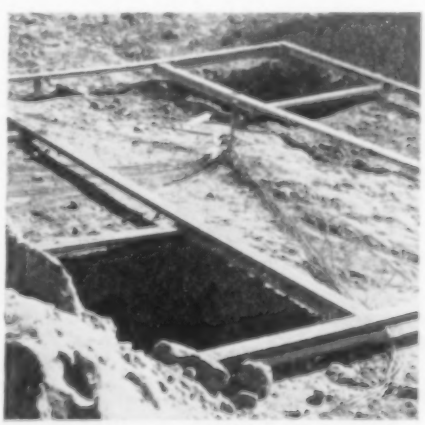
IN various parts of our Southwest there is a hardpan rock formation that is locally designated as caliche. It is technically defined as "gravel, sand, or desert debris cemented by porous calcium carbonate." Its composition varies from place to place, but wherever it is found it spells trouble for excavators. Caliche exists at or close to the ground surface in the entire area of Tucson, Ariz., and there, as elsewhere, it is difficult to dig into or through.

A Tucson contracting firm, M. M. Sundy Construction Company, recently had to deal with the material and solved one phase of the problem to its profit by adapting an air-operated tool for driving iron rods into the ground. The job involved the erection of a broadcasting tower and studio for the Old Pueblo Broadcasting Company. In addition to excavating for the foundations, it was necessary to lay a network of antenna ground wires beneath the surface, and this called for much trenching, as well as driving of the terminal rods.

The Tucson caliche is, typically, a consolidated clay that is so hard in some areas that dynamite must be employed to make even small openings for setting posts or planting trees. Most of the site in this instance was covered with old fill material, including refuse and tin cans that had become partly consolidated through the influence of the cementing element in the accompanying caliche. Below this mantle of fill was a layer of very hard caliche. Foundations from previous structures also were present.

The tower was erected in the middle of an irregular tract. From a ground plate, laid underneath the center of the tower, the wires were extended to the boundaries of the field of influence. They were spaced every three degrees around the plate, making a total of 120. Each of these No. 6 copper wires had to be buried at least 18 inches. Those on the east and south sides had to cross streets. At its outer end, each wire was connected to a copper-coated steel rod 8 feet long, which was driven vertically into the ground to more than its full length so that the top would be under cover.

Because of the irregularity of the area concerned, the wires varied in length from 79.2 feet to 360 feet. To embed them it was necessary to dig some 20,000 linear feet of ditches. The contractor, after much effort, succeeded in excavating the latter by using a tractor-drawn "ripper" and following it up with a trencher, finally breaking the refractory caliche so that it could be ditched by a tractor-mounted blade.



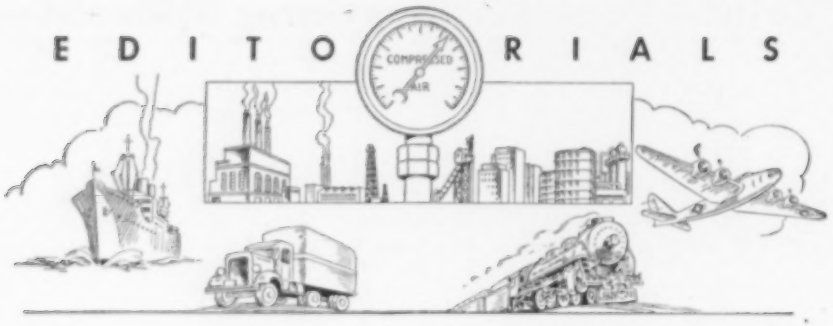
EXCAVATION FOR TOWER

Attached to the pin in the center are 120 wires that were run out to the boundaries of the field of influence in separate trenches. At its outer end each wire was connected to an 8-foot-long copper-coated steel rod that was driven into the ground.

Even greater difficulties were experienced when it came to setting the rods. Two laborers, swinging sledges, couldn't put one down in less than 90 minutes. As their wages were $1 an hour, and the electricians, waiting to make wire connections, were drawing $1.75 an hour, it was evident that the cost would run high unless some better driving scheme could be found. The situation was met by making a tool that would permit the work to be done with a pneumatic paving breaker. The contractor took a moil-point steel, such as is ordinarily employed as a demolition tool in a paving breaker, and cut the pointed end off square. To it he then brazed a 12-inch length of 1¼-inch pipe. The open end of the pipe thus became a chuck into which the rod was fitted so that its end abutted the squared-off end of the moil steel. In that way, the latter was made to serve as a hammer to transmit the force of the paving-breaker blows to the rod.

With this improvisation, one man was able to do the driving. Standing on a portable Safeway type pipe scaffold, he started a rod into the ground with an air-operated chipping hammer. Once it was securely embedded he switched to the paving breaker and finished driving it until its top was well below the ground surface. The average time required to set a rod by this method was three minutes, or only one-thirtieth of that (90 minutes) needed for hand-driving. Because the latter procedure called for the services of two men, the actual saving per rod was 87 man-minutes. The total time saved in putting down the 120 rods was, therefore, 10,440 man-minutes, or 174 man-hours.

EDITORIALS



ARMY WEEK

IN LESS than eighteen months after V-J Day, Uncle Sam discharged 8,000,000 wartime soldiers and recruited a new Regular Army of 1,000,000 volunteers to implement the peace terms in every part of the globe. This monumental conversion task, accomplished with a minimum of confusion, was a triumph for the American way of doing things. By way of comparison, it can be pointed out that complete demobilization of the Revolutionary Army required fourteen years, that the Civil War was not over for all the soldiers for ten years, and that some Doughboys of World War I didn't get out of uniform for five years.

America wants and demands peace. We believe in keeping our peacetime Army as small as possible, but world events necessitate maintaining a strong force until some semblance of normalcy is restored. To the end that we may have an efficient Army, Uncle Sam is making regular service attractive and interesting. April 7-12 is Army Week. During that period, exhibits and special events will acquaint the public the country over with just what the Army is doing and point out the opportunities to be found in it for qualified men. It will be an act of patriotic service for each one of us to attend these events and to inform ourselves about this branch of our Government.

THE CROSS OF GOLD

THERE was a time, not long ago, when the term "gold mine" was a synonym for wealth. Doubtless, the world will see such a period again, for the economic pendulum inevitably swings from high to low, and gold mining does best in depressions. For the moment, however, the gold miner is not enjoying fortune's favor.

We have just fought a cyclopedic war in which gold was of relatively little practical importance. True, our soldiers used it to advantage in the North Africa invasion; and even Germany, which financed its huge operations virtually without gold, was quick to gather in any that she could find in the countries she overran. Nevertheless, iron, copper, tungsten, petroleum, and numerous other minerals were the work horses of the war, not gold. Even silver was pressed into service in huge quantities, but gold remained buried at Fort Knox or locked up in bank and mint vaults. In the end, it was another metal, uranium, that put the clincher on the Allied victory.

This does not mean that gold has lost its glamour. It is still the most coveted metal, and yet, peculiarly, production is held down because its official price is fixed while prices of virtually everything else man wants have risen. There are black markets in some Old World countries where gold brings a premium, but gold mines must sell their output through official channels.

Thus we have the strange situation of the gold-mining industry being hard up. In South Africa, premier gold-producing nation, the output has declined steadily since 1941, some mines have been forced to close, and the industry could not exist at all were it not favored with low-cost native labor.

In Canada, perhaps the greatest potential source of gold, the output fell 47 percent from 1941 to 1946. Taking note of the clamor against taxes, the government granted the industry some relief in March. Mining men claim, however, that it is not enough to count materially. In addition to being saddled with high material and labor costs, the gold mines of the Dominion suffered a drop of 10 percent in the price of their commodity when the Canadian dollar was restored to parity with our dollar several months ago.

In the United States, some of the leading gold mines are still unable to resume operations following their wartime closure. They can't pay the wages that will attract miners. At Cripple Creek, Colo., the Golden Cycle Corporation spent $1,000,000 driving the Carlton Tunnel just prior to the war to drain the mines and eliminate pumping costs. A period of postwar prosperity had been forecast as a result, but thus far only negligible production has been attained. Even the renowned Homestake Mine in South Dakota is making a lean profit compared with prewar figures.

Despite these singular facts, those who own gold mines are not giving them away, and the search for new ones goes on with undiminished effort. Half a hundred promising prospects in Canada are being prepared for production, and in the Orange Free State fever runs high in the wake of reports of a second rich bore hole on the Geduld Farm. The mineral-bearing reef lies 5000 or more feet underground, and shafts will have to be sunk that distance before a penny's worth can be recovered. Nevertheless, there is great excitement over the prospects.

Such is man's ardor for gold. There is, of course, sound basis in history for this sort of behavior. For, unless the way of the world changes, the swinging economic pendulum will some day again move to that level where lustrous gold will regain its place in the sun.

MACHINERY AND JOBS

UNTOLD millions of words and hours have been spent in arguing whether machinery makes more or fewer jobs. The man who has just lost a job through the introduction of labor-saving machinery is naturally hard to convince that technologic advances create employment. Yet that same man would hardly advocate that his city should junk its snow-handling equipment and return to shoveling snow into horse-drawn wagons. Nor does he go home and tell his wife to throw out her washing machine, vacuum cleaner, and other mechanical aids that do much to make life easier for her. Neither can we conceive that, if he were suddenly to acquire a factory, he would attempt to run it without the best machinery obtainable We also feel certain that his office force would use typewriters and other modern business machines.

The point we desire to make is that there is more to the argument than whether machinery increases or decreases employment. The subject has many ramifications, one of which is that technology has brought about better living conditions in this country and, consequently, made our lot more enjoyable. During the depression, armies of men worked with picks, shovels, rakes, and other implements. They were employed, but they weren't very happy.

The best pay and the most leisure come when people can multiply their productiveness through machinery. In the United States, industry now has an investment for each worker of around $6000, and a good part of it is in machinery. There is more than 6 hp. available for each shop employee. A hundred years ago, when well-nigh everything depended upon muscular effort, the average annual industrial wage was $248. In the last prewar "normal" year of 1939 it was $1150, and workers had 40 percent more time to themselves than their forefathers of a century ago.

This and That

Tires that Talk

A new device that warns the driver of a car whenever one of his tires begins to lose air pressure holds promising possibilities as a safety appliance. A Monel-metal button is mounted on each wheel rim and connected through wiring to a buzzer and row of lamps in a box on the dash. When the pressure in a tire drops, the buzzer goes into action, notifying the driver, and by observing which light is on he learns what tire needs attention.

* * *

Teachers to Attend Classes

Fifty college and university professors who teach diesel engineering will receive up-to-date instruction during the week of June 23 under the auspices of the Diesel Engine Manufacturers Association. Using a Chicago hotel as headquarters, they will visit engine factories in that general area, as well as the engineering laboratories of Illinois Institute of Technology and Northwestern University. Classroom lectures on various diesel-engine topics will supplement these tours. No entrance fee will be charged, and the first 50 applicants will make up the enrollment.

* * *

Gas Filled Cables

The Pennsylvania Electric Company is driving an 8-foot-diameter tunnel 1030 feet long under the Schuylkill River in the Philadelphia area to carry transmission lines, some of which are now strung across on overhead towers. Three 69-kv. circuits and ten 13.2-kv. circuits will be run through the bore. The cable casings will be filled with dry, inert nitrogen gas under 200 psi. pressure. They will be built with stop joints for sectionalizing the pressure. To dissipate electrical losses and to prevent mutual heating among the circuits a blower will force air through the tunnel at all times.

* * *

Pumps Lead All

The most used machine in the United States is the pump. This fact was disclosed by Richard H. DeMott, a vice-president of SKF Industries, Inc., in reporting on a survey he conducted to determine the leading field of application for ball and roller bearings. He estimates that there are 100 million pumps in the nation, as compared with 34 million automobiles, 20 million refrigerators, and 28 million telephones. Automobiles, plumbing, air conditioning, and refrigeration are the greatest pump users, there being at least one in every motor vehicle. One of the most promising prospective outlets are the country's 5,800,000 farms, only 1,679,000 of which are now equipped for pumping water. Among basic industries, chemical processing leads in the number of pumps employed, with metalworking second. Other important fields are the oil and dairy industries. The centrifugal pump, invented 215 years ago by the Frenchman, LeDemour, is the most common type and handles such diverse liquids as soup, castor oil, chocolate syrup, and catsup.

* * *

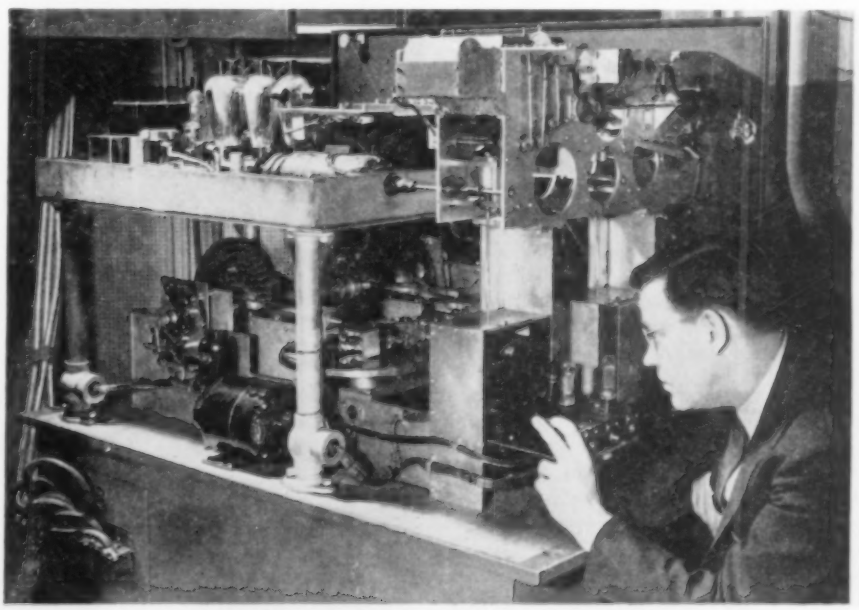
Deep Hole Race

Pacific Western Oil Company and Superior Oil Company of California are waging a neck-and-neck contest for the world's oil-well depth record. Near Lost Hills, Kern County, Calif., Pacific Western's "wildcat" well reached a record depth of 16,668 feet on December 2. Work was stopped when a drill pipe stuck. Two months later, Superior's well in Caddo County, Okla., reached the same depth, halted temporarily to change drill bits, and then resumed operations. It is now below the 16,668-foot mark. Meanwhile, it is reported that Pacific Western will deepen its hole. The National Supply Company of Pittsburgh, Pa., which furnished the casing for both wells, reports that the pipe in the Superior well weighs approximately 284 tons and that in the Pacific Western well, which is smaller, weighs 170 tons.

* * *

Windshield Defrosts Itself

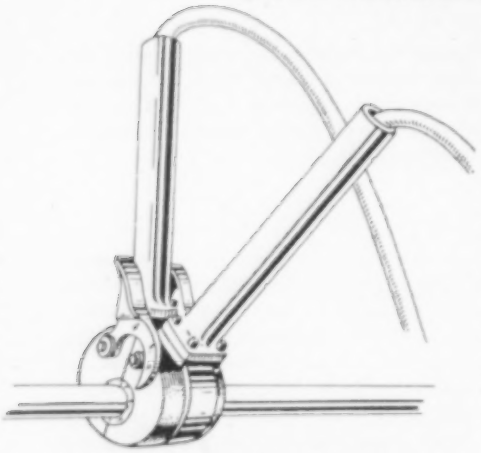
Some new autos coming off the production line have self-defrosting windshields which, if they live up to the claims made for them, will be a boon to winter driving. They consist largely of Nesa glass that was developed during the war by the Pittsburgh Plate Glass Company to prevent the accumulation of static charges on airplane instrument panels. The new windshield is composed of a current-conducting material sandwiched between two sheets of the special glass which, being resistant to the passage of electricity, induces heat. It is this heat that does the defrosting. The current is supplied by a 6-volt alternating-current generator and is stepped up to 110 volts as it is conducted through the windshield. Juice from the same source serves the auto's electric system, but for that purpose it is rectified to 6-volt direct current. Operated by an individual switch and thermostatically controlled, the defroster begins to work as soon as the engine is started.



TESTING TURBINE NOZZLES

The steam that drives large turbines in power plants races through the nozzles at speeds up to 1200 miles an hour, twelve times as fast as hurricane winds. To effect ever greater efficiency, engineers are continually striving to improve nozzle design. The machine shown was built by General Electric Company to test sample nozzles, and records the energy transmitted, as well as the over-all energy loss. For convenience, compressed air is substituted for steam and is blown through the nozzle at varying pressures while the observer notes the changing effects and a printer over his head makes a permanent record for subsequent study.

Freezing Unit Facilitates Repair of Water Service Pipes



IN OPERATING POSITION

Each chamber of the hinged freezing unit has its own 2-bore hose which connects it with a compressor and through which methyl chloride is circulated to form the ice plug by which a broken service pipe is cut off from the water-supply main. The gas is liquefied through compression and returned to the compressor after gasification in the expansion chambers. There is a hook on each side of the tool to lock it in place, and split copper bushings of varying sizes permit its use on pipes with a maximum outside diameter of 1½ inches.

WHEN a water service pipe is damaged, the question is how to repair it without the need of shutting off an entire section of the supply main and inconveniencing all the consumers tapping that section. To make this possible, the Freez-seal Equipment Company, Ltd., a British concern, has developed a portable unit by means of which the leaky pipe is isolated from the system by a plug of ice formed at a point between the break and the water main.

The equipment consists of a small compressor driven either by a 1-hp. gasoline engine or a motor, of a hinged pipe-freezing attachment, and of two auxilliaries—a pipe-closing tool and a controlled-drip tool. The working procedure is as follows: First a pit is dug beneath the damaged area, and then, in the case of a lead or copper conduit, the closing tool is applied to the pipe to squeeze the walls together and thus to stop the flow from the main. Next, the other auxilliary is put in position directly above that closure. The latter is really a clamp, the upper moving jaw of which has a projecting wedge that pierces the pipe when the jaw is screwed down. Holes drilled in the wedge communicate with an outlet valve that permits the water, which is under pressure, to drip from the valve at a controlled rate. The preparations are the same with steel or iron pipe except that a sleeve, containing a small drip valve and a split rubber bushing, is used instead of the closing tool. The former is clamped on the pipe at the point of leakage.

Everything is now in readiness for the attachment of the freezing unit upstream of the zone of operations. To form the ice plug, methyl-chloride gas is liquefied through compression and delivered by way of twin double-bore hoses into two expansion chambers. These encircle the pipe and grip it firmly when their handles, which also serve as a support for the flexible lines, are forced apart. The tool is built like a pair of pliers, as the accompanying line drawing shows. After being reconverted into gas in the chambers, the methyl chloride returns to the compressor by way of the other passageways in the hose lines for reliquefaction and recirculation.

Freezing of the water in the pipe is effected progressively by allowing only small quantities to pass through the controlled-drip tool. Ice first forms against the walls and builds up gradually toward the center, the resultant plug remaining hollow until there is nothing more to freeze than an almost thread-like flow. Damage to the pipe through expansion is thus guarded against. With the service pipe isolated from the supply main, the work of repair can begin. The defective piece, including the parts where the auxilliaries were attached, can be cut out and a new length wiped in.

New I-R Carbide Jackbit Promises Faster Drilling

A NEW detachable rock-drill bit, with cutting edges of Carboloy cemented carbide that give it far greater drilling speed and durability than can be obtained from conventional steel bits, has been announced by the Carboloy Company of Detroit, Mich. The bit has been developed coöperatively with Ingersoll-Rand Company, which will manufacture it. It is not yet available in commercial quantities.

The ultrahard Carboloy (tungsten carbide) cutting edges are inserted in a new 4-point, stud-type Ingersoll-Rand Jackbit. The inserts are made by the powder-metallurgy technique. Powdered tungsten and lampblack are united under high heat to form tungsten carbide. The latter, in powder form, is then mixed with a metallic binder such as nickel or cobalt, pressed into the desired shape, and sintered under high temperature to make the inserts. Only the 1½-inch-size carbide bit will be made at first.

Sample bits have been extensively tested in the field for several months and the results have been so favorable that the Carboloy Company claims the new bit will have a revolutionary effect upon certain kinds of rock drilling. Its greatest application is expected to be in the mining industry, where its superior performance may, it is said, make it possible to mine some marginal properties that are now idle. Among the specific claims made for the bit by the Carboloy Company are:

A service life up to 200 times that of a steel bit. Six of them, weighing 3 pounds, will drill more rock than 450 steel bits weighing 225 pounds.

A complete deep blast hole can be drilled with one bit without interruption, whereas several changes (with a reduction in gauge size each time) must be made with steel bits. This results in faster drilling, permits starting holes smaller, and reduces the over-all amount of rock actually drilled. Corollary benefits are 25 percent to 50 percent more blast holes with the same air consumption and the use of lighter, easier-to-handle drilling equipment.

Reduction or elimination of drill-bit maintenance, less physical effort by miners in drilling, and less weight to transport between blacksmith shops and drilling places.

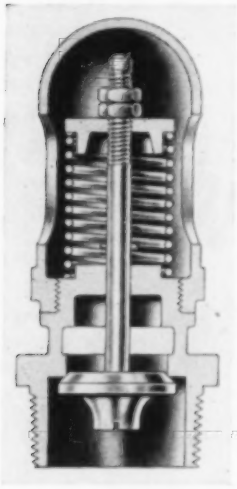
Further details will be announced by Ingersoll-Rand Company when manufacturing plans have been completed.

COMPARISON OF BITS

At the left is shown a steel Jackbit after drilling 2 feet in granite. In the center is a Carboloy-insert bit after drilling 249½ feet in the same rock. An unused Carboloy-insert bit is shown at the right.

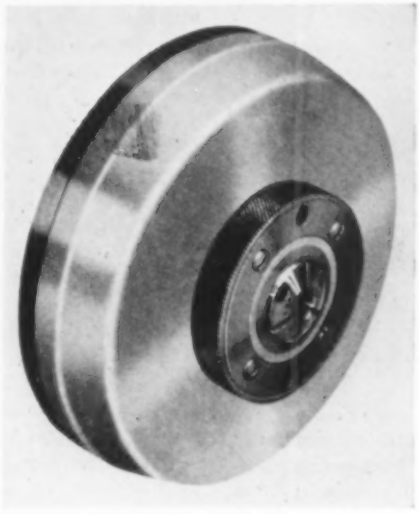
Industrial Notes

The purpose of the Schade No. 1724 Vacuum Breaker, which is distributed nationally by the Associated Valve & Engineering Company, is to give extra protection to jacketed kettles, closed tanks, hot-water generator coils, and heating units. The device is said to prevent collapse by admitting air into such units when the inside pressure drops below a predetermined subatmospheric point. The stainless-steel spring can be adjusted for a set absolute pressure and is inclosed to prevent alteration of the setting through tampering or accidental bumping. Single-seated, tight-closing, and of all bronze construction, the vacuum breaker is furnished in six sizes ranging from ½-inch pipe-thread connection and an over-all height of 4⅛ inches to 2-inch connection and 6¼-inch height.



Designed primarily for drilling oil wells, plastic-coated steel piping made by the Spang-Chalfont Division of the National Supply Company is said to have many other uses. For the latter purpose it has to be protected both inside and outside, but present production is confined to 4½-inch-diameter drill pipe which only needs to be lined. This is done by upending the sections in racks after the inner surfaces have been shot-blasted and by forcing the liquid plastic up into them. Slow draining to prevent air bells or streaks is followed by drying and baking. These operations are repeated four times, thus providing a coating that is claimed to be impervious to oil and water, as well as resistant to corrosion, mild abrasion, moderate chemical attack, and temperatures up to 400°F.

Numerous advantages are claimed by Modern Collet & Machine Company for its Almco Jet-Type Collet Chuck that differs radically from conventional units of its kind. It is designed for use with hand screw machines and engine lathes up to 1-inch capacity and is opened by admitting air at 100 psi. line pressure to the chuck body through a circular channel and seal ring. The air nozzle does not come in contact with the chuck, thus eliminating wear and lubrication difficulties. Opening can be effected with collet in any position if stationary, or at any speed up to the maximum speed of the fastest machine, and there is no danger of accidental opening in case of failing air pressure. Collet is



closed by spring action and held in position by a locking plunger that prevents loosening or change in adjustment with rotation in either direction. Gripping pressure is adjustable in twelve positive steps from zero to 15,000 pounds, thus permitting thin-walled tubing to be held without distortion and bar stock without slippage for hogging cuts up to the full horsepower of the machine. Collets are available in sizes up to 1 inch, round, hex, and square.

Lightness, insulating properties, and structural strength are claimed for a new core material recently announced by E. I. duPont de Nemours & Company, Inc. Sandwiched between and cemented by thermo-setting resins to sheets of metal, wood, or plastic, the "substitute cork" is suitable for use in building aircraft, refrigerators, furniture, prefabricated houses, luggage, trucks, boats, etc. It is made by heating a mixture of cellulose acetate and other materials under pressure. When the latter is released, the mix becomes a foamy mass of bubbles the size of a pin point. As it issues from the heater it chills into a hard, cellular product that may be tooled or shaped with any woodworking machinery. At present it is being manufactured in strips ranging in weight from 4 to 9 pounds per cubic foot.

To the man who plans building a frame house, the prospect of using lumber that is already painted and will remain so sounds like a good investment. We are told this is not a figment of the imagination but a possibility as a result of the vacuum-pressure method of impregnating softwoods with dimethylolurea to give them the properties of hardwoods, as described in our September, 1944, issue. By mixing dyes with the plasticizing agent, which is forced into the wood with compressed air after

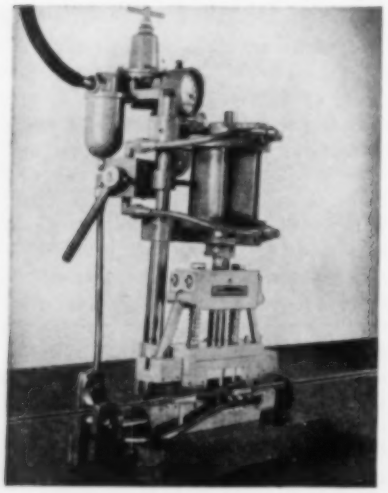
A new type of fixed, variable-pitch V-belt pulley known as Spiralok is being produced by Scientiae Corporation. It locks on to the shaft by a spiral wedging action that eliminates setscrews, as well as threads or keyways on the shaft. In fixed position it is in rigid alignment and permits making numerous adjustments. Pulley will drive in either direction. It is said to be well adapted for use with air-conditioning, refrigerating, and ventilating equipment; with air compressors, conveyors, and textile machinery; and with pumps and other motor-driven V-belt-connected units. It is also suitable for the home workshop.

the cells have been evacuated, the lumber is not only made hard but is permanently colored throughout.

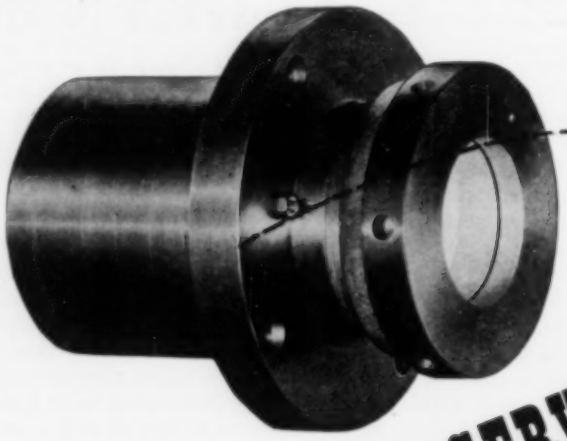
Cordage of a new sort, offered by the Carolina Industrial Plastics Corporation, is said to possess properties that qualify it for exacting indoor and outdoor service. Besides being flexible and strong, it is described as being weather-, rot-, and flameproof, impervious to acids, and resistant to abrasion. The core is of stout rayon and is jacketed by a tough polyvinyl-chloride plastic. Named Chemclad, it is available in almost any size and length and in a variety of colors.

A new glazing material that can be cut to size with scissors and nailed to framing is announced by Richkraft Company. It is a shatterproof, transparent plastic that is said to transmit more than 60 percent of the sun's ultraviolet rays. Among its recommended uses is that of closing in buildings during construction and outdoor scaffolding to provide more comfortable working conditions in winter. The material, named Richglaze, is supplied in 36-inch-wide rolls containing 150 and 450 square feet.

To facilitate the work of stripping one, two, and three conductor wire up to ½ inch in diameter, The Williams Products Company has designed a pneumatic bench-type machine that simultaneously performs the three basic operations of cutting the wire and of slitting and stripping the insulation. Either one or both ends of a wire can be



processed by the equipment, which consists essentially of adjustable hardened-steel knives and of a Bellows-Senacon air cylinder. The knives are mounted in a head assembly, and when this is forced down by the cylinder piston with air at 60 psi., a central blade severs the wire and side blades slit the insulation. Further downward movement of the



PROVEN IN SERVICE!

France Metal Packing is called upon daily to meet conditions of service thought impossible only a few years ago. Not content with meeting all standard conditions, France has pioneered in design, engineering and adaptations of materials to meet many unusual and exacting requirements. France Packings are successfully meeting the demands of modern high speed machines with their higher pressures and higher temperatures. They are particularly successful in handling poisonous, corrosive and inflammable gases, at pressures exceeding 15,000 pounds.

For lower maintenance costs and trouble-free operation of engines, compressors and pumps, install or replace with France Metal Packing. *Write Today for our latest Brochure . . . Industrial Packing.*

FRANCE PACKING COMPANY
PHILADELPHIA 35, PA.

REPRESENTATIVES IN PRINCIPAL CITIES

piston then brings two arm-mounted side heads in contact with two similar heads that slide on horizontal bar supports on the base of the machine. These grip the wire and, when pushed outward by the piston, pull it through two sets of blades which remove the insulation. Any loose bits in the operating area are blown away by the cylinder air exhaust. The Codeco wire stripping machine is suitable for small- or large-scale operation and is said to have a capacity of 700 wires an hour.

What is described as an ultrasensitive air-velocity or flow meter is being offered by the Hastings Instrument Company, Inc. The device is based on the hot-wire and thermopile principle of operation, which is said to increase accuracy by minimizing errors due to variations in air temperature. Instrument uses 110-volt alternating current, which may be obtained either from wir-

ing or a portable power-pak and battery. The meter is suitable for making surveys of heating and air-conditioning systems, for measuring wind velocities and the flow in air and other gas lines, etc. Its standard range is from 0 to 2000 feet per minute, and velocities as low as 5 feet per minute can be measured and registered with accuracy, it is claimed, either on standard strip or circular-chart electric recorders. Instrument may be adapted to indicate results at a remote point.

Air Reduction Sales Company has developed a process and equipment by which dissolved hydrogen that causes porous areas in castings is removed from molten steel. The undesirable element is flushed out by bubbling dry nitrogen or argon through the fluid mass by means of a tube. Just how that is done is not revealed. The company is prepared to act as consultant for specific applications.

"VIC" VICTAULIC SAYS...
"RIGHT IN THE GROOVE, MISTER...
FOR PIPE COUPLINGS THAT LOCK!
"It's a fact! No plain end pipe jointing method comes near equalling the strength of Victaulic grooved pipe couplings... because the special groove in the pipe locks Victaulic Couplings fast and sure. They can't pull out or blow off!
"And to double-top it all, Victaulic Couplings give you a flexible line... at LESS COST than the threaded-and-coupled pipe jointing method.
"Specify Victaulic 'grooved ends' when next you order pipe. Then, for leak-tight, slip-proof locks at every joint, use Victaulic Couplings. Their 'two-bolt' simplicity permits easy sectional repairs... and 100% salvageability!"
It will also pay you to look into the complete line of Victaulic Full-Flow Elbows, Tees and other fittings. For economy, efficiency, long lasting service... make your pipeline all-Victaulic!
Write for new Victaulic Catalog and Engineering Manual
VICTAULIC COMPANY OF AMERICA
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
Victaulic, Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 200 Bay St., Toronto 1
For export outside U. S. and Canada: PIPECO Couplings and Fittings:
Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Have you considered Victaulic for your piping requirements?
Sizes — ¾" through 60"
Copyright 1947, by Victaulic Co. of America
SELF-ALIGNING PIPE COUPLINGS
VICTAULIC
EFFICIENT FULL-FLOW FITTINGS

Industrial Literature

A magnetic screen trap for the removal of extraneous solids from lines carrying liquids or gases is described in Bulletin 101 issued by the maker, Cooney Valve & Screen Manufacturing Company, Erie, Pa. The trap has an Alnico magnet for capturing ferrous materials and a screen for removing nonferrous ones.

The Chemox oxygen-breathing apparatus made by Mine Safety Appliances Company, Pittsburgh 8, Pa., is described in Bulletin B-14. This equipment generates its own supply of oxygen in accordance with the needs of the wearer. It has been used by the U. S. Navy for four years and is approved by the U. S. Bureau of Mines.

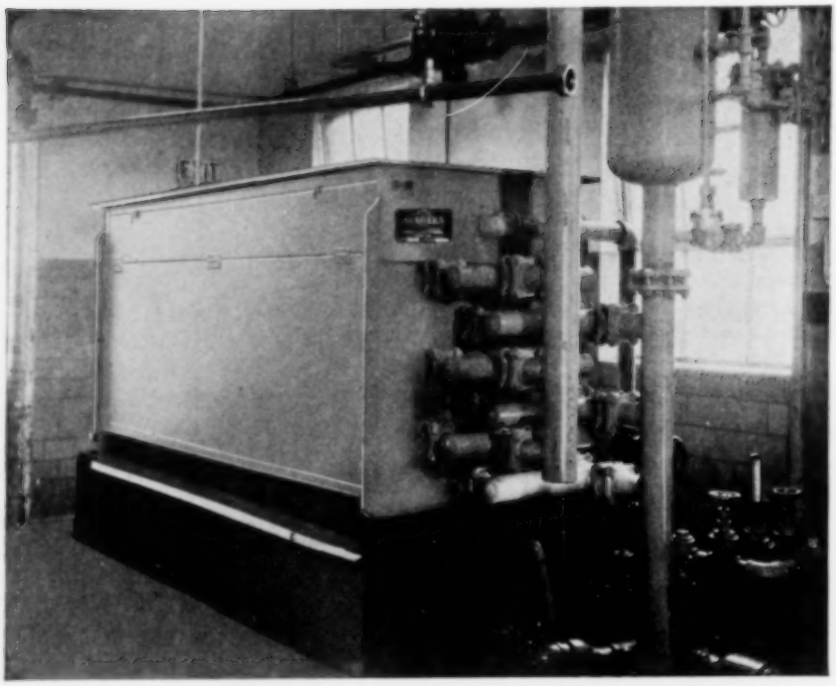
B. F. Goodrich Company, Akron, Ohio, offers a new (fourth) edition of its 40-page *Rivnut Data Book*. Developed for attaching de-icers to airplanes, Rivnuts perform many other fastening services, especially in the automotive, refrigeration, electrical-equipment, and furniture industries. They are made of aluminum, steel, or brass.

Various industrial dust problems are discussed in a 24-page bulletin issued by American Filter Company, 215 Central Avenue, Louisville 8, Ky. It includes a chart showing the sizes and characteristics of air-borne solids, and there are sections dealing with the application of the firm's filters in the treatment of air for different services. The publication is listed as Form 502-A.

A new 68-page bulletin published by Cochran Corporation describes hot-water softeners that remove corrosive gases, silica, and other scale-forming material from boiler feed and industrial process waters. It includes flow diagrams, construction drawings, engineering tables, and an appendix of feed-water chemistry. The bulletin, Publication 3000, is obtainable from the company at Seventeenth Street and Alleghany Avenue, Philadelphia 32, Pa.

A new 4-page leaflet issued by Norton Company, Worcester 6, Mass., describes its line of Norbide abrasives. Called the hardest material made by man, Norbide is the company's trade-marked name for boron carbide. It is used by lapidaries and for the lapping of many industrial materials that have traditionally been treated with the much more costly diamond dust. The publication is listed as Form 559. Norton Company also offers a 24-page bulletin, Form 803, that gives up-to-date information on its line of Alundum and Crystolon refractories. These are available in bricks, plates, fabricated muffles, recuperator tubes, burner blocks, and miscellaneous shapes for production furnaces heated by gas, coal, oil, or electricity.

Those who are inclined and equipped to keep their own cars in tip-top running order will be interested in a new book, *How to Tune Up Your Automobile*. The author is Jack Steele, California state headlight adjuster, who has written other books for motorists. Although it will serve as a manual for the trained mechanic, the text can be understood by the average car owner, and there are numerous sketches and pictures to keep him from going wrong. A generous section of the 239-page volume is devoted to "case histories," in which typical trouble jobs are followed through, step by step. The book sells for $2.50, and is obtainable from Norman W. Henly Publishing Company, 17 West Forty-fifth Street, New York 19, N. Y.



NIAGARA LIQUID COOLER
Gives High Capacity in Small Space

Cold water, chilled to 33° F., or cold liquids, or non-freezing solutions below 32° F. are produced economically by the new Niagara Liquid Cooler.

For large capacity equipment it is most compact. For example, one model furnishes 92 gallons per minute of water cooled from 45° F. to 35° F., with 28° F. refrigerant temperature, in less than 30 sq. ft. of floor space. Other models . . . from 24 to 465 G. P. M.

Extra advantages are positive temperature control; assurance of holding temperature accurately in spite of variation in cooling load; rapid chilling of the liquid; savings in power and refrigeration consumption.

Write for Bulletin No. 100-CA.

NIAGARA BLOWER COMPANY

Over 30 Years' Experience in Industrial Air Engineering

405 Lexington Ave. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Fish zip through hose — a ton a minute

A typical example of B. F. Goodrich improvement in rubber

FISHERMEN spend days getting a cargo—only to damage and lose as much as a twelfth of their fish, shoveling them from boat to cannery dock. And it takes hours—while fish aren't getting any fresher.

A New England canner, who had seen oil tankers unloaded by B. F. Goodrich hose, came to B. F. Goodrich with the idea that fish might be unloaded the same way.

B. F. Goodrich studied the problem and then recommended a certain kind of hose with a very soft rubber lining so that fish wouldn't be bruised as they had been by the hand method of shoveling. A method was worked out by which fish and water were sucked through the hose, so the water "floated" the fish smoothly.

The new system worked perfectly. Instead of hours by the old method, the B. F. Goodrich hose unloads a 65-ton cargo in minutes—food is saved, fish reach the cannery fresher, boats get back to the fishing grounds sooner. It has made such savings that scores of other fish companies are investigating, and want to adopt it.

Transporting materials of all sorts at lower cost is only one of the many contributions B. F. Goodrich research has made to American industry. Before you're satisfied with any product or process, it pays to find out what developments B. F. Goodrich has been making recently. To find out, call your B. F. Goodrich distributor or write *The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio.*

B.F.Goodrich

FIRST IN RUBBER

For assured flow control, the valve must suit the service

You don't have to be an Isaac Walton to know what's wrong with these fishing pictures. Silly misapplications of equipment, aren't they? But no sillier than using *valves* in services for which they were not specifically designed.

Through more than a hundred years of making valves—and valves only—Powell Engineers have been designing the *right* valves to suit the specific requirements of every existing industrial flow control service. Today, the Powell Line includes Bronze, Iron and Steel Valves of every necessary type, design, size and pressure. And, for corrosion resistance, Powell makes a notably complete line in the widest range of pure metals and special alloys ever used in making valves.

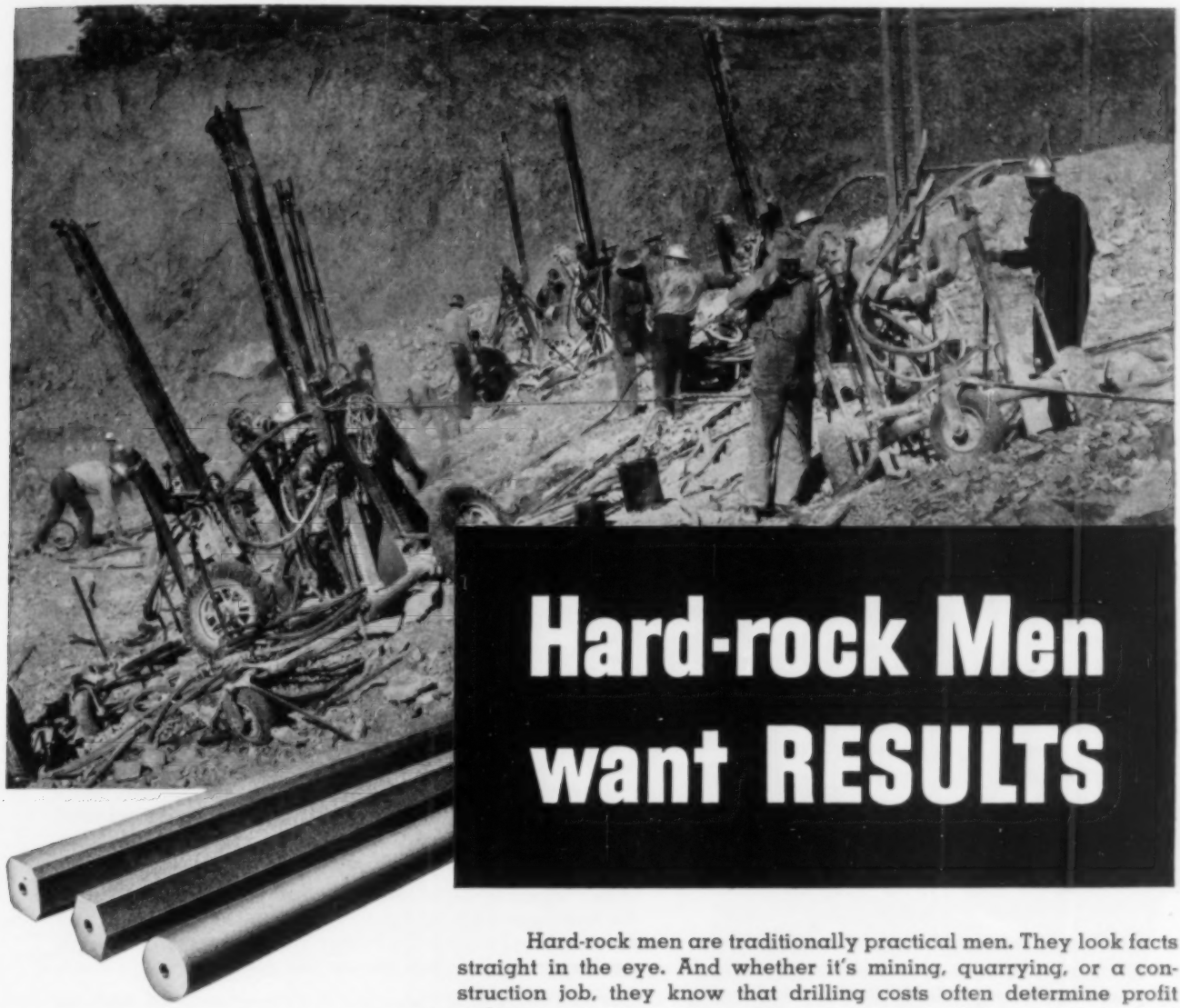
That's why, *for assured performance*, it pays to consult Powell.

Bronze Dash-Pot Check Valve for 200 pounds working air pressure especially designed for air compressor service. The disc and dash-pot plunger are of "Powellium", a wear-resisting, non-corrosive nickel-bronze alloy. In closing, the action is cushioned by the operation of the plunger in the dash-pot thus reducing pounding to a minimum.

125-pound Iron Body Bronze Mounted Globe Valve. Has bolted flanged yoke, outside screw rising stem, renewable bronze seat and renewable composition disc. Suitable discs are available for controlling the flow of air or of water for cooling air compressors.

The Wm. Powell Co.
Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES



Hard-rock Men want RESULTS

Hard-rock men are traditionally practical men. They look facts straight in the eye. And whether it's mining, quarrying, or a construction job, they know that drilling costs often determine profit or loss.

That's why so many hard-rock men insist on Bethlehem Hollow. It's known everywhere as the "old reliable." Whether used for detachable or forged-on bits, there's no better steel for hard-rock drilling.

It's available now for prompt shipment from your nearest supplier.

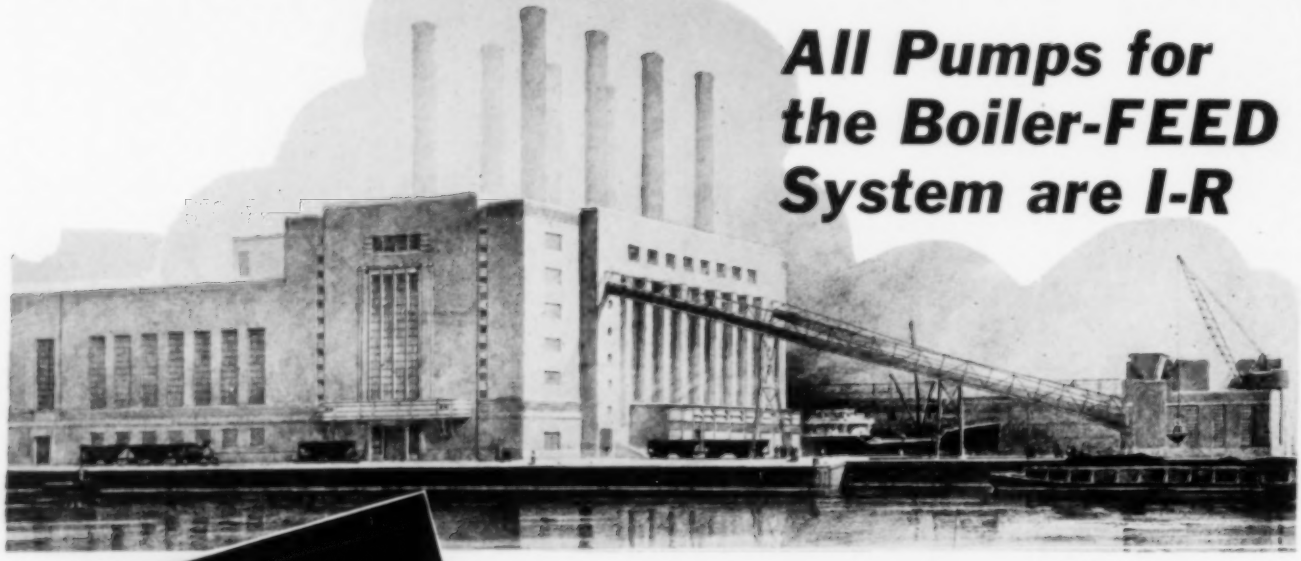
- ★ Bethlehem Hollow is always true to size. It forges easily to close dimensions.
- ★ Its wide quenching-range makes it easy to heat-treat for the ideal hardness.
- ★ Forged-on bits, shanks, and threads stand up under long, severe service.
- ★ The hole is smooth, true, and well-centered, minimizing fatigue failure.
- ★ Rock drill repair costs drop when Bethlehem Hollow is on the job.

BETHLEHEM HOLLOW DRILL STEEL

BETHLEHEM STEEL

AT THE NEW SOUTHWARK STATION OF THE PHILADELPHIA ELECTRIC CO.

All Pumps for the Boiler-FEED System are I-R

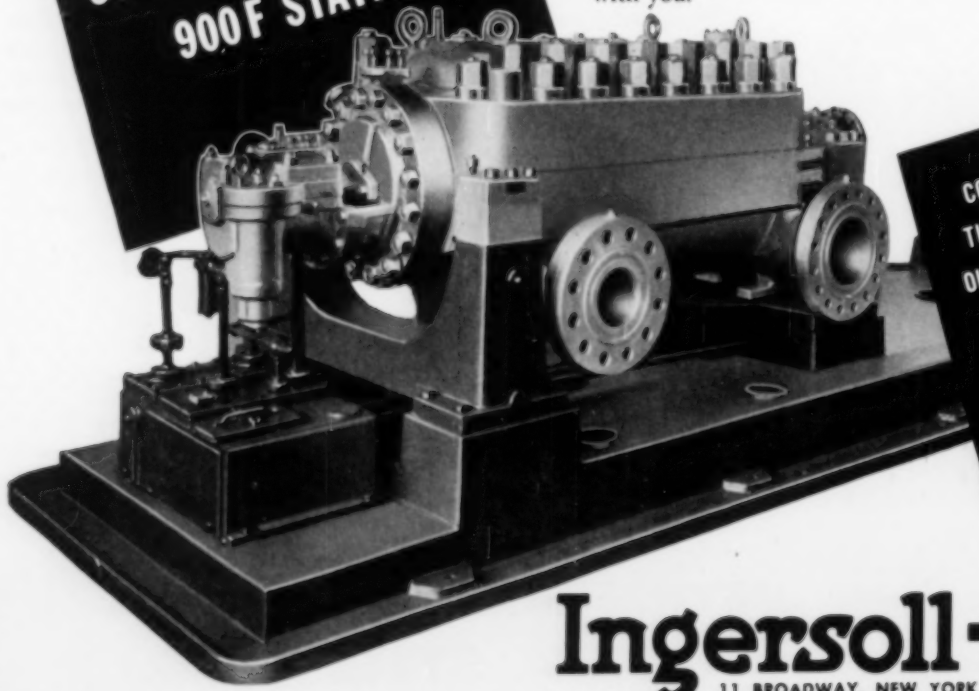


18 PUMPS TOTALING 15,150 HP *Serve* 300,000 KW, 850 PSI, 900 F STATION

The six high-pressure feed pumps are 2400 gpm, 770 psi total head (discharge pressure approximately 1275 psi), 7-stage units operating at 1750 rpm.... Low pressure units of the same general design are each 2000 gpm, 550 psi total head, 5-stage, 1750 rpm....The six vertical condensate pumps are 2200 gpm, 130 ft total head, 860 rpm.

Other Ingersoll-Rand pumps in the station include those for hydrogen cooling, for boiler filling, for city water and for water-seal service. Two large synchronous motor-driven I-R compressors furnish the air for station service.

Our engineers will appreciate the opportunity of working with you.

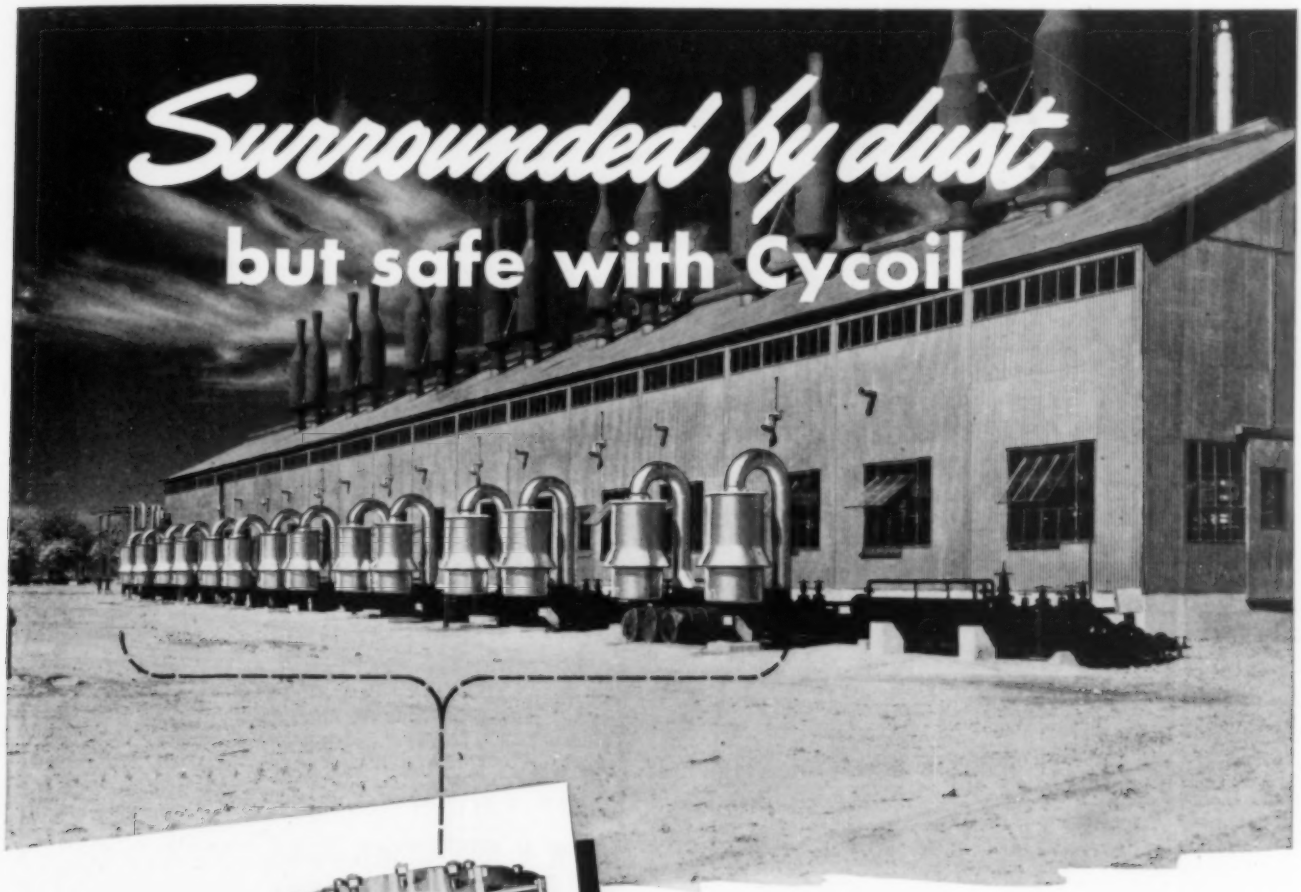


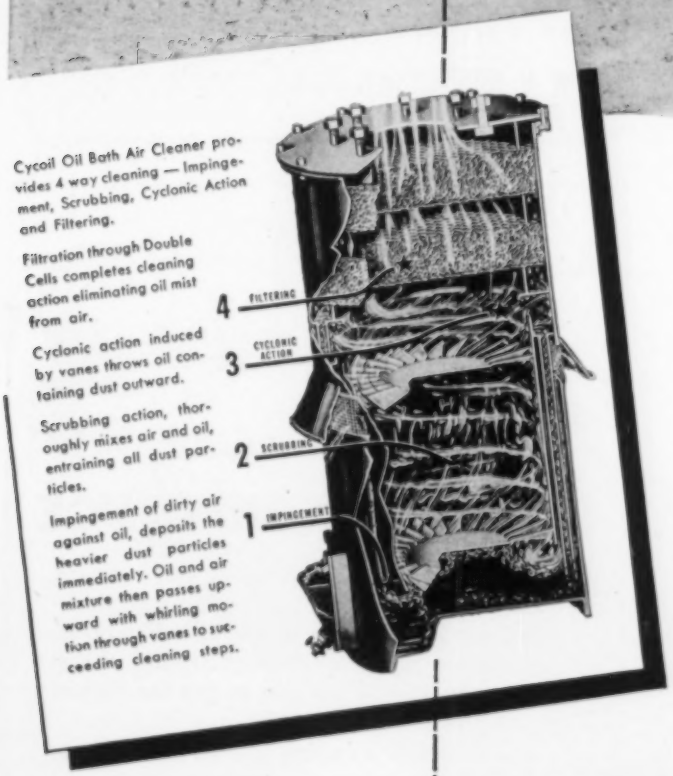
COMPRESSORS
TURBO BLOWERS
OIL & GAS ENGINES
PUMPS
CONDENSERS
AIR TOOLS
ROCK DRILLS

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 10-918

Surrounded by dust but safe with Cycoil





Cycoil Oil Bath Air Cleaner provides 4 way cleaning — Impingement, Scrubbing, Cyclonic Action and Filtering.

Filtration through Double Cells completes cleaning action eliminating oil mist from air.

Cyclonic action induced by vanes throws oil containing dust outward.

Scrubbing action, thoroughly mixes air and oil, entraining all dust particles.

Impingement of dirty air against oil, deposits the heavier dust particles immediately. Oil and air mixture then passes upward with whirling motion through vanes to succeeding cleaning steps.

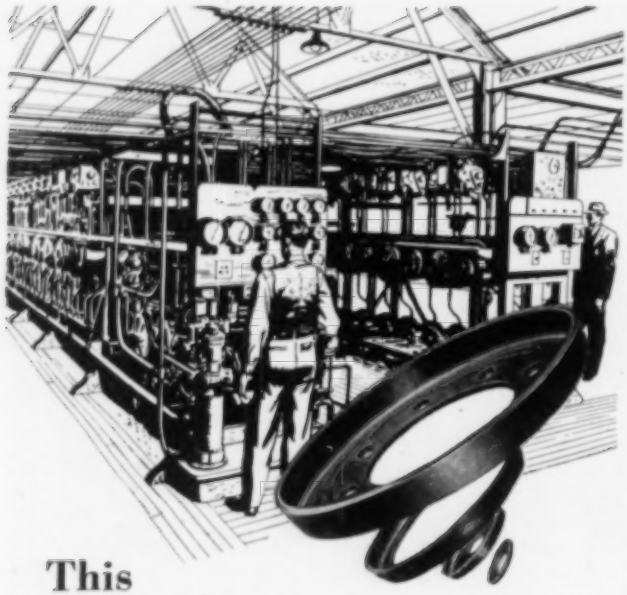
THIS compressor station is surrounded continually by heavily dust-ladened air yet the engines are free from the damaging effects of grit and dirt. The answer is obvious—each and every unit enjoys the permanent protection of a Cycoil Oil Bath Air Cleaner.

Nothing short of perfection gets by in the dust country. Cycoil delivers practically 100% cleaning efficiency because it is a heavy-duty oil bath cleaner of large dust-holding capacity designed and built for this exacting service. Over 90% of the total fine dust content of the air is trapped in a Cycoil even before reaching the filter cell. Positive oil circulation for continued self-cleaning action, plus the additional filtration to be had in the filter pads, makes for approximately 100% clean air.

"Play it safe with Cycoil" has become a by-word with operating and maintenance men the world over. Reasons why are contained in Bulletin 130-D. Write for it today.

AMERICAN AIR FILTER COMPANY, INC.
402 CENTRAL AVENUE • LOUISVILLE 8, KY.
In Canada: Darling Bros. Ltd., Montreal, P. Q.

AAF **Cycoil OIL BATH AIR CLEANER**
AND INTAKE SILENCER



This "STATIONARY TRAIN" helped develop *Piston Packing Cups* that serve you better.

PRODUCTS today have to be designed for a *buyers* market . . . and the *extras* in service, in economy, and in freedom from maintenance will decide the sale. If your product utilizes pneumatic or hydraulic cylinders, you can add this margin by installing Wabco Piston Packing Cups.

The material for these cups was developed to meet the need for air brake cylinder packing that would stand desert heat or mountain cold, could get along with lubricants, and that would retain resilience and sealing properties for extended periods. Test equipment like the "stationary train" illustrated helped give the packing its initial check-up, but the most convincing test is provided by the hundreds of thousands of installations that have served dependably for years, on railroads all over the globe.

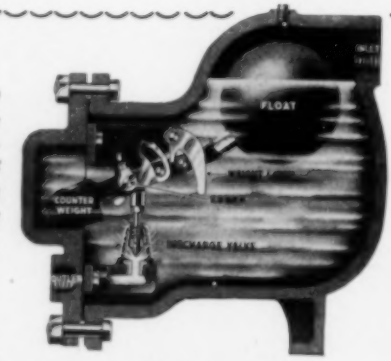
Wabco Piston Packing Cups are available for original installation in ¾-inch to 30-inch diameters for pneumatic cylinders and $1\frac{3}{16}$-inch to 7-inch sizes for hydraulic cylinders. The exclusive limited compression feature can be furnished in sizes from 1-inch to 7½-inches. Ask for Wabco Packing Bulletin.

Westinghouse Air Brake Co.
Industrial Division - - - Wilmerding, Pa.

NICHOLSON

LEAK-PROOFS *traps by positive* FLUID SEAL

Elimination of troublesome air loss in discharge is one of the advanced features of Nicholson weight-operated traps.



Cut Work on Trap Maintenance

Other features admired by maintenance men:

(1) Instantaneous action due to weight operation.

(2) Rugged, to take unavoidable abuse.

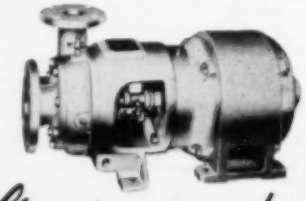
(3) Hardened stainless steel, where it counts.

(4) Easily connected.

Traps for Every Purpose: weight-operated, pressures to 1500 lbs.; piston-operated, thermostatic and expansion, for medium pressures.

W. H. NICHOLSON & CO. 180 OREGON ST. WILKES-BARRE PA.

A GOOD TROUPER



gives the public what it wants—

GOOD PERFORMANCE

The Motorpump is designed and built for continuous, rugged service under tough working conditions. It thrives on diets like brine, chemicals, petroleum products, alkalis or suspensions. It will pay you to put the Motorpump in *your* show.

Sizes ½ to 40 hp. • 5 to 1800 gpm. • 5 to 600 ft. head.
Materials: Iron, Bronze, or a combination of both.

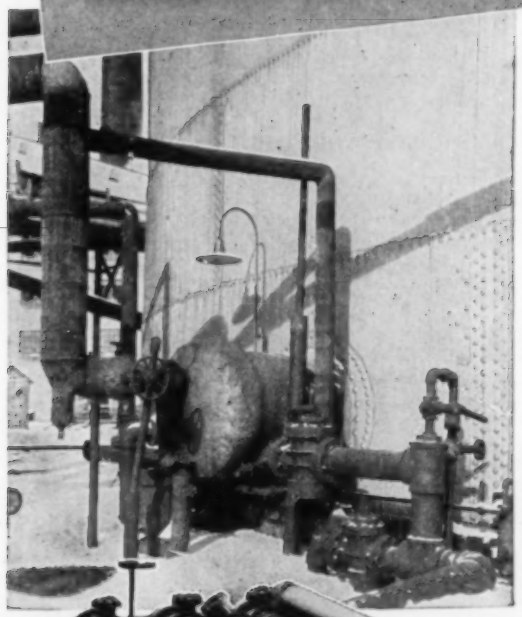
Write Ingersoll-Rand Company, 11 Broadway, New York 4, New York or our nearest branch office for Form 7093 the 40-page Motorpump catalog.

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

9-921

Speed up Oil Flow

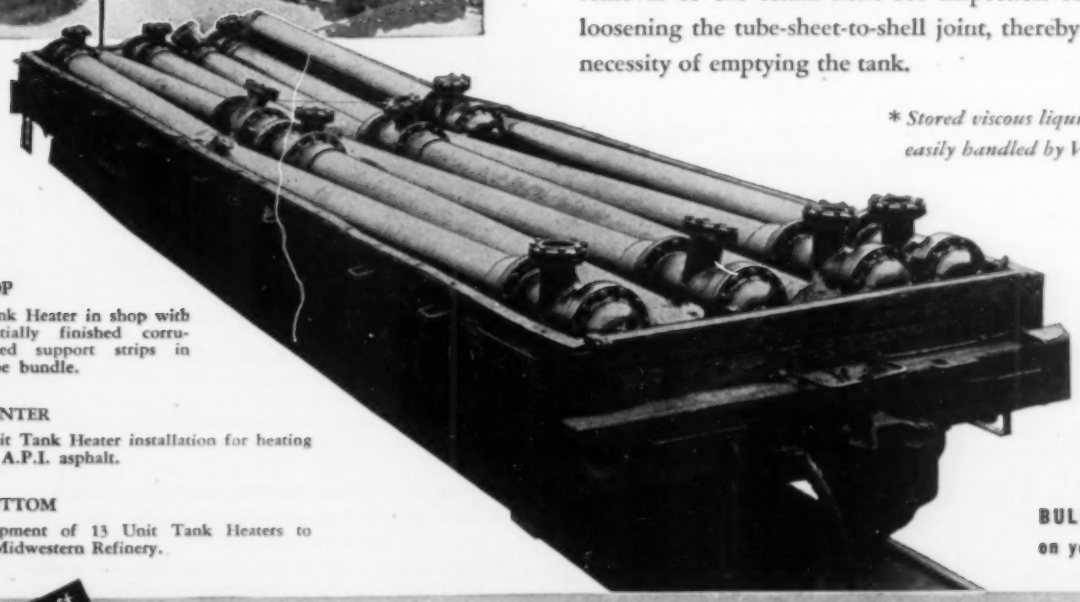
WITH Vogt UNIT TANK HEATERS *



SAVE TIME AND MONEY with Vogt Tank Heaters! They permit pumping to be started shortly after steam is admitted since only the small quantity of oil lying in the shell of a unit needs to be heated. As hot oil is withdrawn it is replaced by cold oil from the tank through the open end of the heater shell. Steam consumption is held to a minimum since *only* the oil removed from the tank is heated.

Standard Type U Heaters have nests of "U" bend tubes made from 1¼" seamless steel or 1" electric welded pipe, as desired. These are rolled firmly into tube sheets having double grooved tube holes. Corrugated strips support the tubes without impediment to the oil flow. Collar bolts permit removal of the steam head for inspection or repair without loosening the tube-sheet-to-shell joint, thereby eliminating the necessity of emptying the tank.

** Stored viscous liquids of any kind are easily handled by Vogt Tank Heaters*



TOP
Tank Heater in shop with partially finished corrugated support strips in tube bundle.

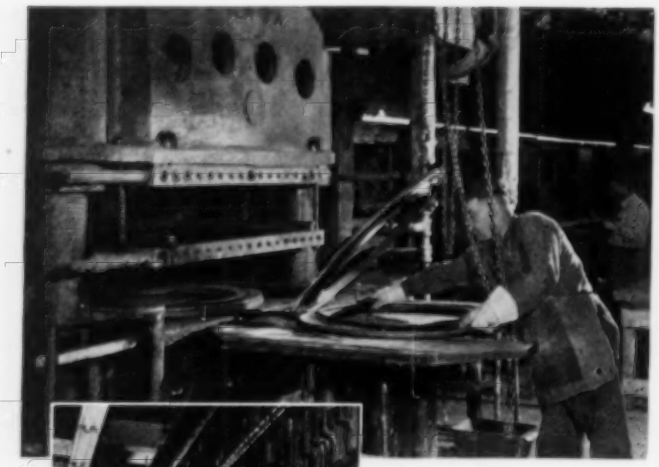
CENTER
Unit Tank Heater installation for heating 12 A.P.I. asphalt.

BOTTOM
Shipment of 13 Unit Tank Heaters to a Midwestern Refinery.

Write for BULLETIN HE-4 on your letterhead

HENRY VOGT MACHINE CO., INC., LOUISVILLE 10, KY.

Branch Offices: NEW YORK · CHICAGO · CLEVELAND · PHILADELPHIA · DALLAS



Top photograph shows the molding of a large Chevron ring. Photo at left shows a few of the thousands of molds of various sizes. Below is photo of Chevron packing which shows unique hinge-like construction.

It Takes Plenty of "Know How"

FROM specially prepared *quality controlled* Garlock materials experienced craftsmen mold Garlock Chevron, the automatic packing with the exclusive hinge-like construction.

The greater the pressure the tighter it packs; as pressure decreases the packing contracts. Friction on the rod and on the packing itself is thereby reduced to a minimum . . . Specify GARLOCK 430 Chevron for hydraulic service; 431 for oils at low temperatures; 530 for steam, air or gas; 531 for hot oils.

THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK *Chevron* PACKING

Here is the pair for clean, dry air . .

JOHNSON AFTERCOOLER

Used where moisture is vaporized by the heat of compression. Circulates cooling water around the line, condenses the oil and water vapor so Separator can remove them. Simple in design, highly efficient in performance.

SIZES FOR ALL NEEDS

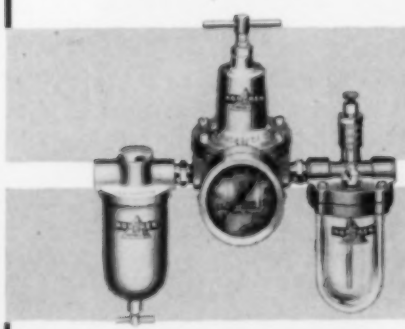
JOHNSON SEPARATOR

Removes more than 99% of all water, dirt and oil from compressed air or steam. Combines the *two* best principles of separation—first allows air to expand slightly, then changes flow direction with the "Thousand Baffles". Model illustrated is the newest idea in separator design, with self-draining trap mechanism built right in.

WRITE FOR BULLETIN

The Johnson Corporation
830 Wood St., Three Rivers, Michigan

SPEED UP PERFORMANCE • REDUCE WEAR



Install a Norgren Lubro-Control Unit. Make air tools and cylinders operate smoother and faster. Reduce excessive wear and corrosion.

Compact, accessible assembly. Filter, regulator or lubricator available separately, or in any combination.

- filter stops solids, moisture and oil emulsion.
- regulator controls air power, supplies right pressure for maximum performance.
- lubricator injects clean oil fog into air stream. Cuts wear, prevents rust and corrosion.

Get the facts. Write for catalog 400

C. A. NORGREN CO.
222 SANTA FE DRIVE
DENVER 9, COLORADO

Norgren

FOR AIR COMPRESSORS

class 9213AH3

PRESSURE SWITCH

200 lbs. pressure limit
15 to 40 lbs. differential

• A two-pole device for intermediate-sized motors. Simply-designed, huskily-built mechanism delivers long life and trouble-free operation with a minimum of servicing.

Quickly wired. Range and differential easily adjusted in the field. Offered with or without pressure-release valve for easier motor starting.

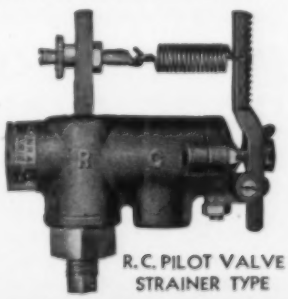
Write for Bulletin • photos, specifications of Square D pressure switches and related devices. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors...installed as replacements on thousands of compressors in all parts of the U.S.A. and overseas. The R-C valve—positive in action—cannot chatter...it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R.C. PILOT VALVE STRAINER TYPE

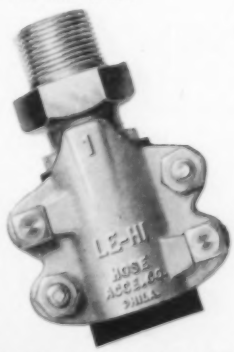
R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

---

There's NO PRESSURE DROP on HIGH PRESSURE LINES when LE-HI HOSE COUPLINGS ARE CARRYING THE LOAD

LE-HI Series 100 Universal Type Hose Couplings. Applicable for compressed air and many special uses where a quick detachable coupling is desirable.

LE-HI Series 400-W and G Female Washer or Ground Joint Type Coupling with I.P.T. Spud. Sizes ¾" and smaller furnished with two-bolt clamp and 1" and larger with four-bolt clamp.



LE-HI Series 500 Male Hose Coupling, companion unit for LE-HI Series 400-G and 400-W. It is completely adaptable to the widely diversified applications where the female units are used.

Ever stop to think how much it costs you every time your compressor runs full time . . . without cutting in and out?

Compressors and other primary equipment have to work "overtime" too often because of leaks caused by faulty hose couplings and fittings. Guard against pressure drop and loss of expensive power by using LE-HI Hose Couplings on your hose lines. Put the wear and tear on LE-HI . . . not on the equipment that costs thousands of dollars.

For example, on air compressors, pile driving equipment, road pumps, jetting pumps, and other hydraulic equipment, or for conveying air or steam under high pressure, specify LE-HI Series 400 and 500 Hose Couplings. Powerful clamps grip the coupling securely to the hose so that it will not leak or blow off.

Avoid pressure losses and costly shut downs. Specify LE-HI . . . a diversified line of hose couplings for industrial and construction use.

Sold Only
THROUGH DISTRIBUTORS

HOSE ACCESSORIES CO.
2716 North 17th Street, Phila. 32, Pa.

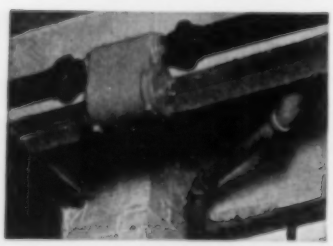
LE-HI
HIGH and LOW PRESSURE HOSE COUPLINGS

DEPENDABLE PNEUMATIC SERVICE

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper – resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

MORE THAN MEETS THE EYE

Just looking at the KOH-I-NOOR PENCIL doesn't begin to tell the story. It's when you actually use one that its superiority becomes immediately evident.

The KOH-I-NOOR Drawing PENCIL is made of the finest cedar grain and the finest lead. In every field where a pencil is used—art, engineering, designing or office work—KOH-I-NOOR is the choice.

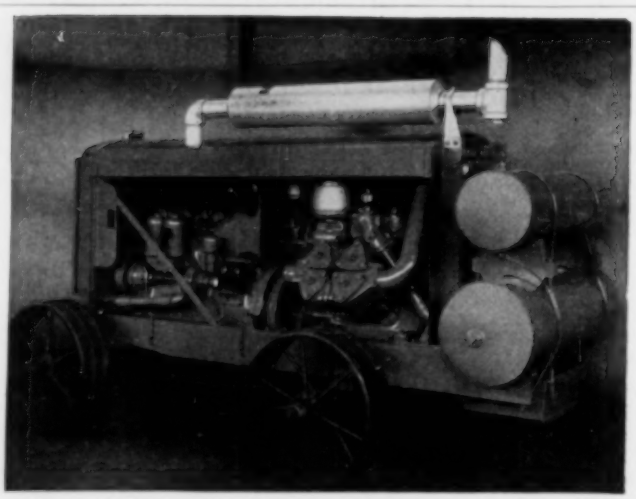
The RIGHT Pencil For Your Job

SEND FOR LEAFLET NO. 19

KOH-I-NOOR

The RIGHT pencil for the RIGHT job

KOH-I-NOOR PENCIL COMPANY, INC., BLOOMSBURY, NEW JERSEY



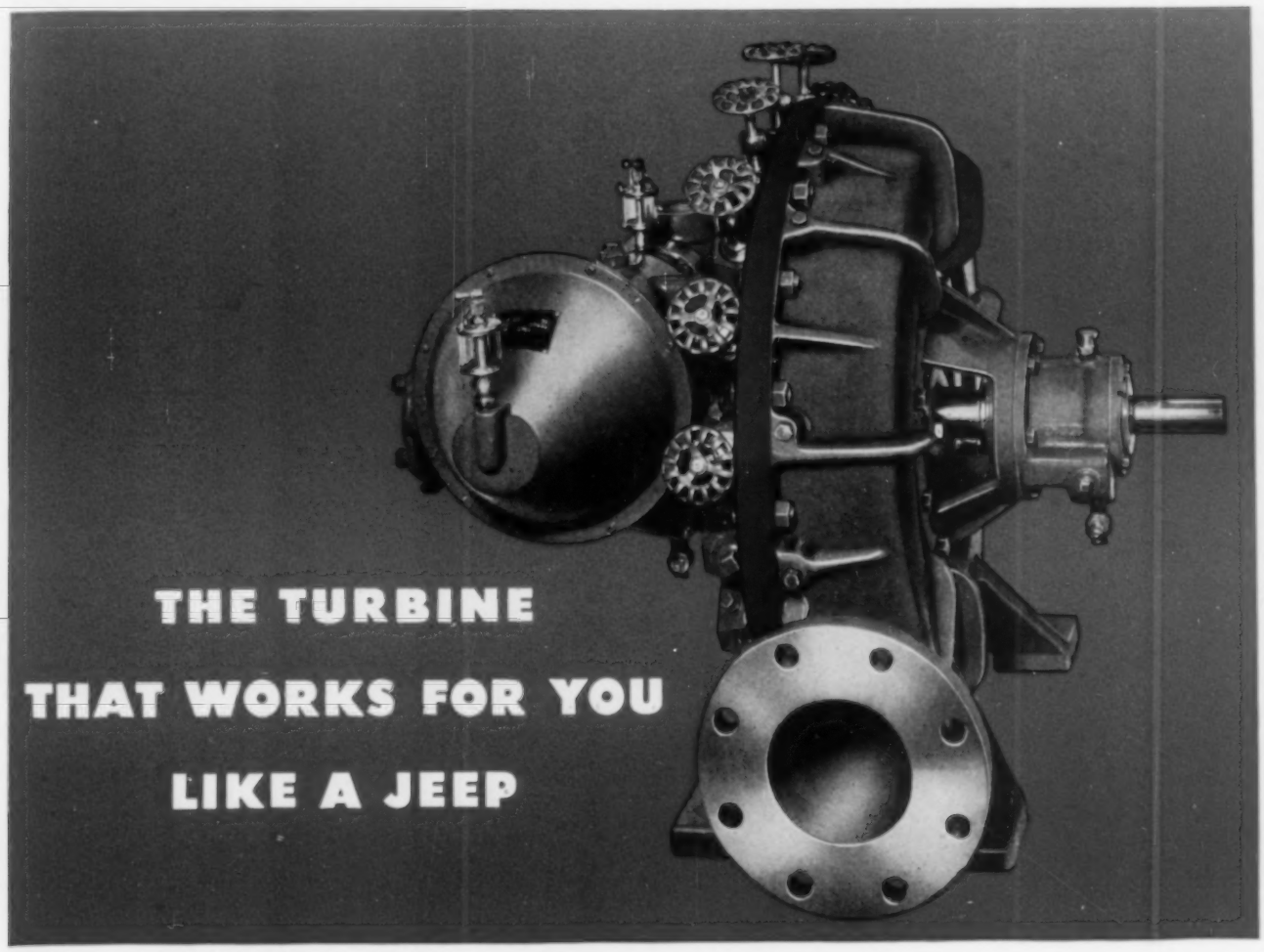
MAXIM EQUIPPED FOR GOOD PUBLIC RELATIONS

A portable compressor is apt to spend its service life in many locations where noise is a nuisance to nearby homes and offices. It is good public relations to provide adequate silencing and good practice to choose Maxims for this job. For superior silencing of engine exhaust and intake, compressor intake, steam or air blow-off; for spark arresting or silencing with the heat recovery feature, specify Maxims. Detailed bulletins on request.

THE MAXIM SILENCER COMPANY

61 HOMESTEAD AVENUE, HARTFORD 1, CONN.

MAXIM SILENCERS



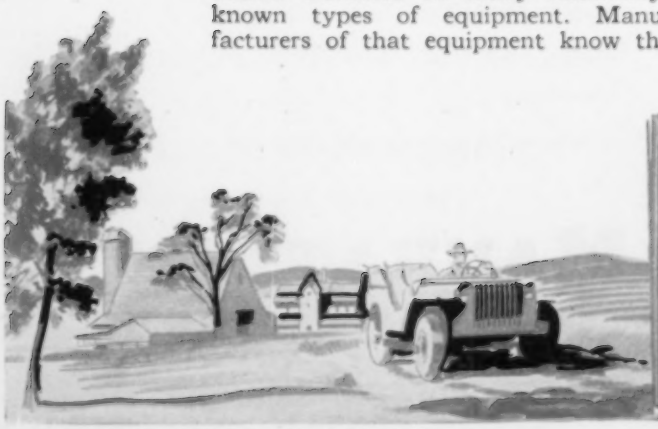
Small, but powerful . . . like a jeep. That's the Coppus Steam Turbine that you see around so many places powering pumps, blowers, fans, stokers and other equipment requiring a steady, sturdy source of small HP.

The Coppus line of "Blue Ribbon" turbines runs from 150 HP down to fractional — there are six frame sizes, and prices are in proportion. You can match a Coppus turbine to the job, saving the money you might otherwise spend for a turbine that's larger than necessary.

You'll see Coppus "Blue Ribbon" Steam Turbines on many nationally-known types of equipment. Manufacturers of that equipment know the quality that is represented by the Coppus "Blue Ribbon" — more than 85% of all orders since 1937 has been repeat business.

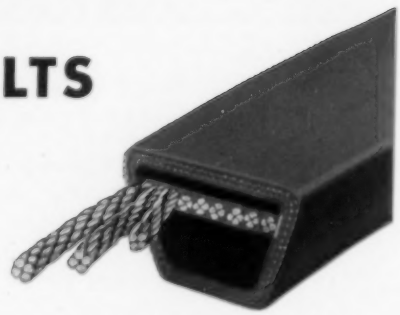
Select the right size of Coppus turbine for any job that calls for "jeep duty". Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), they are made to extremely close tolerances with accuracy controlled by Johansson size blanks. Before shipment, every turbine is dynamometer-tested.

Write for Bulletin 135-10. Coppus Engineering Corporation, 204 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in SWEET'S.



ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

Condor WHIPCORD V-BELTS



Where high speed and constant operation of machinery are vital to a process, you can't beat Condor Whipcord V-Belts.

In malt production, for example, huge blowers must move air at rates up to 200,000 cubic feet per minute —first, cool humidified air during the germinating process—then hot, dry air to dry the malt after germination.

It is on machinery like this that Condor Whipcord V-Belts deliver their best. Despite the terrific test of short center drives at high speeds, Manhattan's *Flexlastics* dissipate heat and permit the Whipcord Strength Members to give longer service.

Also, the *Flexlastic* cushion in a Condor V-Belt seats it firmly in the sheaves to deliver every possible unit of power to the driven shaft.

Whether your drive is two belts or twenty, make sure you get all "pull" for your power costs by using CONDORS.

(Bulletin No. 6868 B describes 8 acknowledged advantages.)

"Flexlastics" is exclusive with Manhattan

RAYBESTOS-MANHATTAN INC.

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION **PASSAIC, NEW JERSEY**

FOR BETTER DRILLING IN ROCK OR COAL

MEET THE HARD-HITTING LIGHTWEIGHT J-30

A NEW JACKHAMER

It has

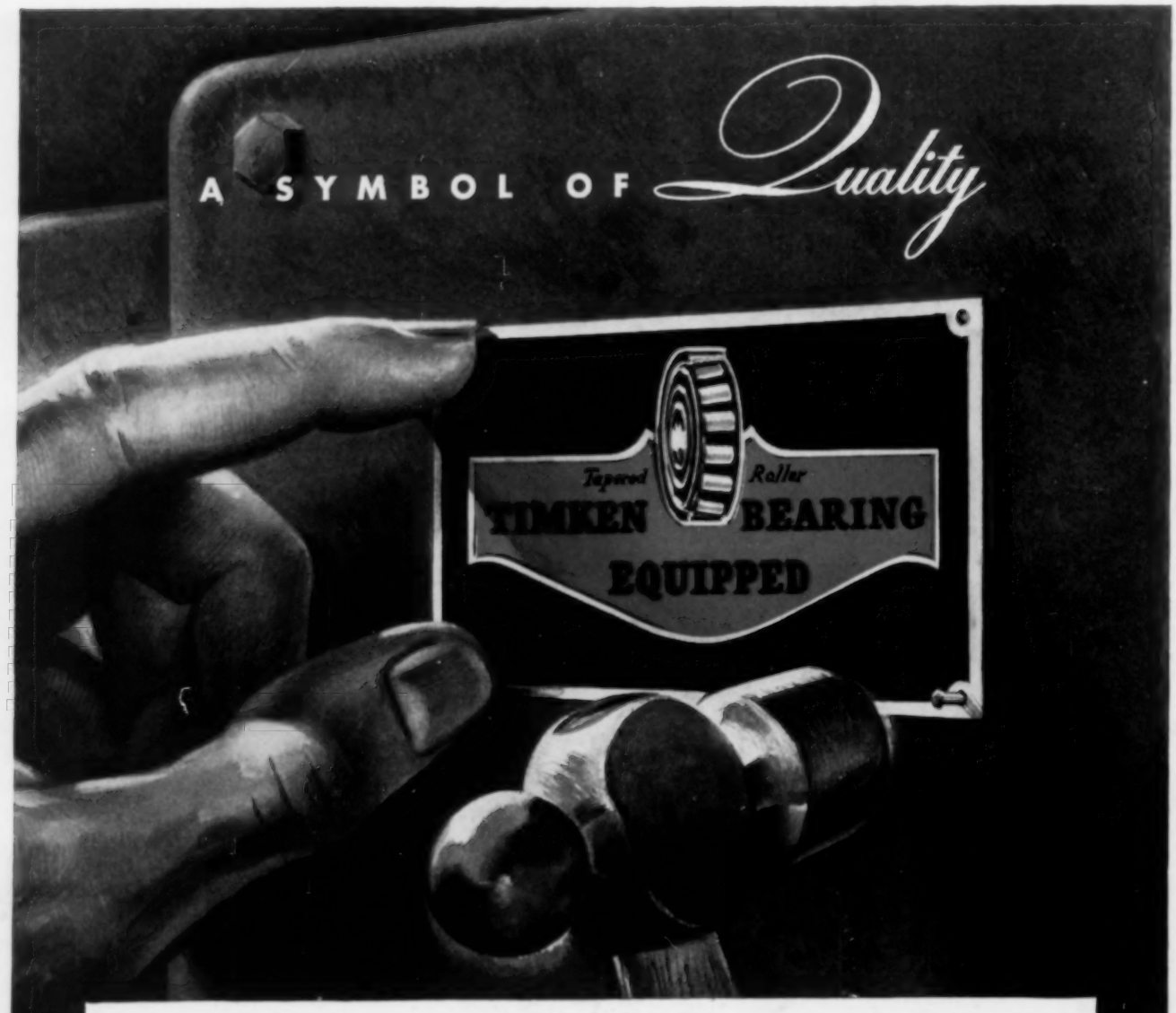
- A three-in-one backhead *(wet, dry or blower).*
- A sealed throttle valve *(dust and dirt free).*
- 3-piece chuck construction *(chuck, chuck driver and bronze chuck driver nut).*
- A "fighting heart" kicker port valve.
- Generous bearing faces for rigid joints.
- Raised open grip handle *(optional).*
- Rider pads for off-plank drilling.
- Smooth, powerful rotation.

ROCK DRILLS • COMPRESSORS
AIR TOOLS • PUMPS
TURBO BLOWERS • OIL ENGINES

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

S-978



Put It On Your Products NOW!

When you identify your machines as "Timken Bearing Equipped" you greatly increase their value in the eyes of the prospective buyer; for the use of Timken Tapered Roller Bearings has been associated with top-notch equipment of all kinds for so long that the "Timken Bearing Equipped" symbol has become a Symbol of Quality wherever it appears. Thus Timken Bearings make better machines and *better-selling* machines. If you are using Timken Bearings, why "hide your light under a bushel"? Tell the world about it. It's a sales plus you can't afford to overlook. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS